Illustrated Guide to Some Hornworts, Liverworts and Mosses of Eastern Canada

Robert R. Ireland
and
Gilda Bellolio-Trucco

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ILLUSTRATED GUIDE TO SOME HORNWORTS, LIVERWORTS AND MOSSES OF EASTERN CANADA

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and
Gilda Bellolio-Trucco

Glossary and Structure Illustrations by
Linda M. Ley

Botany Division
National Museum of Natural Sciences
National Museums of Canada
Ottawa, Ontario,
K1A 0M8

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National Museum of Natural Sciences

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ABSTRACT

An illustrated identification guide is presented for some of the common or distinctive bryophytes occurring in eastern Canada. Only superficial (25-50x) features are utilized for identification of the plants. Included in the guide are 2 hornworts, 79 liverworts and 154 mosses that occur from Newfoundland to southern Manitoba.

Information is given on the life cycle and structure of bryophytes, on collecting and preparing a reference collection, on identification and methods of study and on a few reference books that are available. Keys to the bryophytes are accompanied by illustrations of the superficial characters important for their recognition. The habitat and distribution are listed for each bryophyte. The guide concludes with an illustrated glossary and an index to the bryophytes.

RESUME

Le présent ouvrage est un guide d'identification illustré de certains bryophytes communs ou particuliers de l'est du Canada. Seules les caractéristiques superficielles (25-50x) sont retenues pour l'identification. Le guide décrit 2 anthocéres, 79 hêpatiques et 154 mousses qui poussent de Terre-Neuve jusqu'au sud de Manitoba.

Le guide décrit le cycle évolutif et la structure des bryophytes, montre comment constituer et préparer une collection de référence, comment identifier et étudier des spécimens, et mentionne quelques ouvrages spécialisés. Les clés des bryophytes sont accompagnées d'illustrations de leurs caractéristiques superficielles importantes. Le guide précise l'habitat et la distribution de chaque bryophyte et se termine par un glossaire illustré et un index.

ACKNOWLEDGEMENTS

The usefulness of this guide is enhanced by the habit sketches and accompanying drawings of Gilda Bellolio-Trucco. I am grateful to Linda Ley who did the glossary and structure illustrations (Fig. 2) and helped in all aspects of this work, including the final typing of the manuscript. I appreciate the assistance of Paul Cohen, museum volunteer, and Yves Boudreau, COSEP student, both of whom tested the keys. I thank Eleanor Fenton and Bonnie Livingstone for their assistance with the publication of this guide. Dr. W.B. Schofield, University of British Columbia, read the manuscript and I am indebted to him for his useful comments. Finally, I thank Suzanne Chartrand for the French translation of the guide and Dr. M. Poulin and Miss Kathleen Pryer, National Museum of Natural Sciences, National Museums of Canada, for checking the translation.

CONTENTS

Introduction....5

Life Cycle....5

Structure of Bryophytes

    Hornworts (Anthocerotophyta)....8

    Thalloid Liverworts (Hepatophyta)....8

    Leafy Liverworts (Hepatophyta)....9

    Mosses (Bryophyta)....10

Collecting and Preparing a Reference Collection....12

Identification and Methods of Study....16

Reference Books....18

Keys to Bryophytes....19

    General Key to the Groups of Bryophytes....20

    Key to Hornworts (Division Anthocerotophyta)....21

    Key to Thalloid Liverworts (Division Hepatophyta)....23

    Key to Leafy Liverworts (Division Hepatophyta)....37

    Key to Mosses (Division Bryophyta)....78

Glossary....185

Geographic Abbreviations....202

Index to Bryophytes....203

INTRODUCTION

The purpose of this guide is to acquaint the reader with some of the common or distinctive **hornworts** (Division Anthocerotophyta), **liverworts** (Division Hepatophyta) and **mosses** (Division Bryophyta) that occur in eastern Canada. These plants, collectively called bryophytes, are often abundant in many parts of the country, yet few people are familiar with their names or know how to distinguish one from another. Their small size makes many bryophytes appear alike to the untrained eye but even a casual glance at the illustrations in this guide reveals a vast array of different plants. In fact, there are approximately 550 species of mosses, 200 species of liverworts and 3 species of hornworts in eastern Canada. This guide contains 235 of the most conspicuous bryophytes found from Newfoundland to southern Manitoba, mainly below 50° N latitude.

The guide is intended primarily for the amateur naturalist or student botanist who would like to be able to recognize bryophytes using superficial characters. A dissecting microscope with a 25-50x magnification, available at most universities, is ideal for this purpose. In lieu of this, a 10-20x hand-lens, which may be purchased at university bookstores, museum boutiques or biological supply stores, can be used with some success.

LIFE CYCLE

In order to understand clearly the structure of the bryophytes it is necessary to describe their life cycle. The life cycle of most bryophytes follows a somewhat similar basic pattern, illustrated here using a moss as an example (Fig. 1).

The life cycle begins with the **spore** (Fig. 1: 1). There are generally hundreds to thousands produced by each plant. These small roundish structures, usually only a few micrometers in diameter, have walls that are either smooth or variously sculptured with a network of ridges and processes. After the spore lands in a favourable environment, germination begins and a green, filamentous **protonema** is produced (Fig. 1: 2). The protonema grows to produce a multicellular, branched web that may cover several centimeters of substratum. There are some bryophytes that have a **thalloid** protonema instead of a filamentous one. The protonema forms **rhizoids** to anchor it to the substratum and eventually a small bud (Fig. 1: 3) develops which forms the leafy (Fig. 1: 4-5) or, in the case of the hornworts and some liverworts, the thalloid **gametophyte**. The gametophyte may be unisexual or bisexual and bear **sexual buds** or **inflorescences** (Fig. 1: 6) containing the male sex organs (Fig. 1: 6a), or **antheridia** (sing., antheridium), the female sex organs (Fig. 1: 6c), or **archegonia** (sing., archegonium), or both. Sterile, multicellular hairs, **paraphyses** (sing., paraphysis), are usually intermingled with the sex organs. Each antheridium contains numerous biflagellate sperm cells (Fig. 1: 6b) but there is only a single egg in each archegonium (Fig. 1: 6c). The sperm are released from the antheridia and swim in a film of water to the archegonia containing the egg (Fig. 1: 6c). The fusion of a sperm and an egg results in a progressive division of cells that eventually forms a **sporophyte** (Fig. 1: 7-13). The sporophyte of most bryophytes consists of a **foot**, deeply imbedded in the gametophyte to serve as an absorbing organ for water and food needed for its growth, a **seta** which is a slender stalk of varying length and, at the distal end of the seta, a **capsule** containing the spores. Frequently a membranous hood, or **calyptra** (Fig. 1: 11), which is a remnant of the archegonium, sheathes the capsule. In addition to the spores in the capsule, the liverworts have **elaters** and the hornworts have **pseudoelaters**, which are hygroscopically active, elongate cells functioning as aids for loosening up the spore mass and dispersing the spores.

Besides sexual reproduction, as described above, many bryophytes also reproduce by **asexual** or vegetative means. Specialized branches, parts of leaves, or almost any young cell of the bryophytes may have the capacity to produce a new gametophyte. Quite often, special reproductive bodies called **gemmae** (sing., gemma) are produced in large numbers on the leaves, stems or rhizoids of the gametophyte. Each gemma, after becoming detached from the plant and landing in a favourable environment, is capable of forming a gametophyte and perhaps, eventually, a sporophyte through a series of stages similar to that of the sexually produced spore.

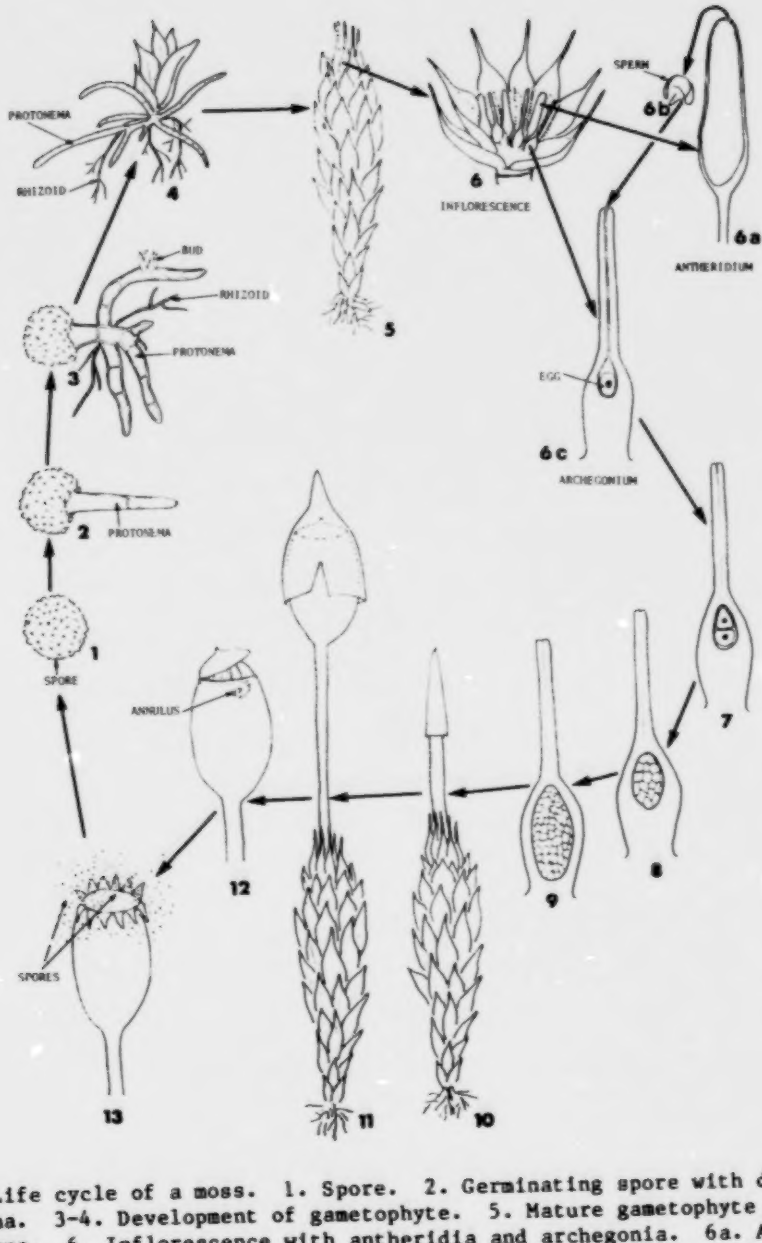

PROTONEMA
RHIZOID
4
BUD
RHIZOID
PROTONEMA
3
2
PROTONEMA
1
SPORE
5
6
INFLORESCENCE
SPERM
6b
6a
ANTHERIDIUM
EGG
6c
ARCHEGONIUM
7
8
9
10
11
12
ANNULUS
13
SPORES

FIGURE 1. Life cycle of a moss. 1. Spore. 2. Germinating spore with developing protonema. 3-4. Development of gametophyte. 5. Mature gametophyte bearing sex organs. 6. Inflorescence with antheridia and archegonia. 6a. Antheridium. 6b. Sperm. 6c. Archegonium and fertilization. 7-9. Development of sporophyte. 10. Gametophyte bearing immature sporophytes. 11. Gametophyte bearing mature sporophyte. 12. Detail of mature capsule before spore release. 13. Detail of capsule showing spore release.

HORNWORTS (ANTHOCEROTOPHYTA)

All hornworts have a small (ca. 2 cm in diameter), flat, nearly circular, irregularly lobed, **thallus** or gametophyte (Fig. 2: 1). The thallus is dark green and translucent, each cell of which contains a single large chloroplast, in contrast to other bryophytes which have several chloroplasts per cell. Cavities in the gametophyte are sometimes occupied by colonies of the blue-green alga Nostoc and appear as dark spots on the surface of the thallus. The sex organs are not visible because they are sunken in the upper surface of the gametophyte. Unicellular rhizoids are located on the undersurface of the thallus. A long, cylindrical capsule (hence the name hornwort), sometimes up to 3 cm long, contains spores and pseudoelaters. The cylindrical capsule is green and arises from a bulbous base attached to the thallus. It is surrounded by a tubular outgrowth of the thallus called an **involucre**. The capsule, which is a long-lasting structure that persists until the death of the gametophyte, splits lengthwise at maturity into two **valves** to release the spores. A slender thread-like, central strand inside the capsule (**columella**) may also be seen when the valves split apart. Each capsule continues to produce new spores throughout the growing season, shedding them as they mature in the upper part of the capsule.

THALLOID LIVERWORTS (HEPATOPHYTA)

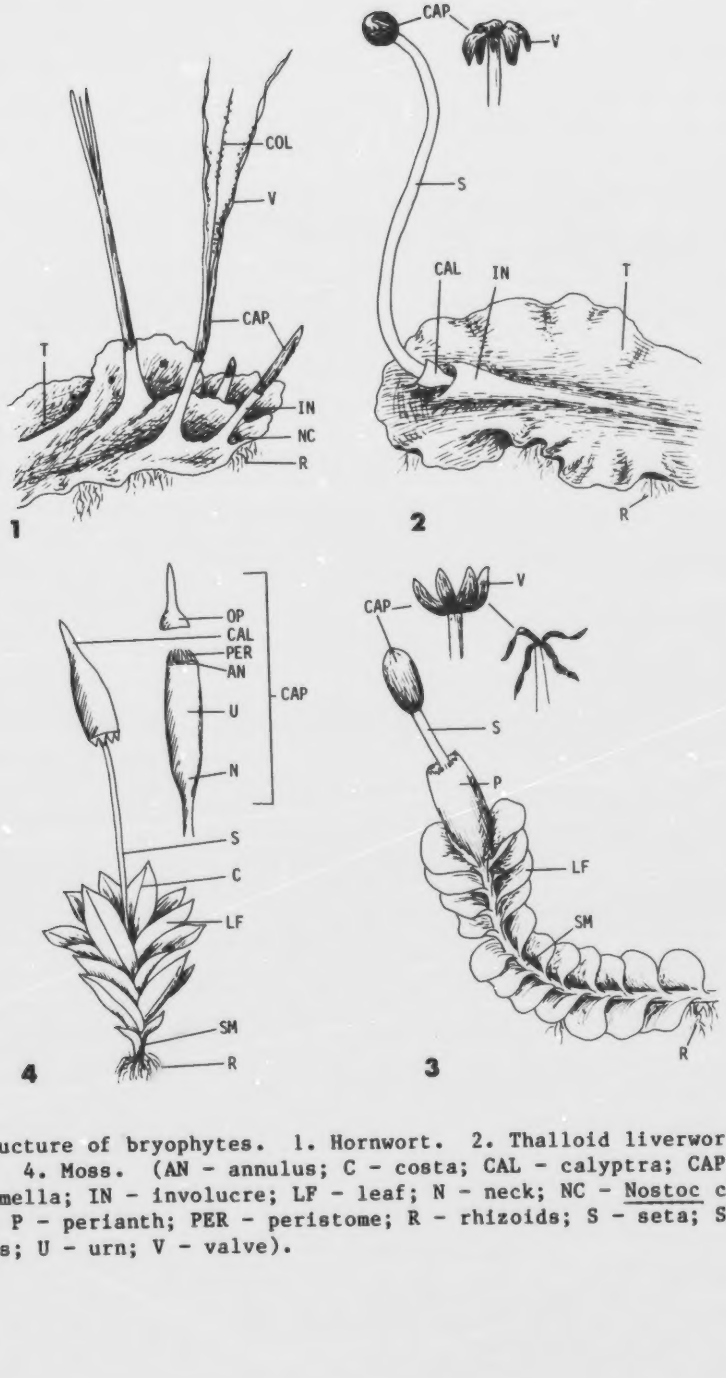
The gametophyte of many thalloid liverworts is more complex than that of the other bryophytes (Fig. 2: 2). The thallus is light green to dark green, occasionally yellowish green, dull, translucent or with a greasy appearance, and the undersurface, especially the margins, is often purplish. The thalli are large, sometimes reaching 1-3 cm wide and 15-20 cm long, flat and variously lobed. They are one (unistratose) to several (multistratose) layers thick. The upper surface often contains pores leading into air chambers and frequently there are diamond-shaped surface markings surrounding the pores. The lower surface of the thallus often bears unicellular rhizoids and sometimes small **scales**. A **costa** is present on the thalli of some species, while dark spots of Nostoc colonies are present on others. Minute green gemmae on the thalli margins or in cups or flask-shaped receptacles on the surface may be present also in some species. The thalli may be unisexual or bisexual with the sex organs variously located on or in the upper or lower surface. Sometimes the antheridia and archegonia are borne on the dorsal surface in specialized stalked receptacles called **antheridiophores** and **archegoniophores**, respectively. The sporophyte is often inconspicuous because the capsule is on a short seta and frequently remains hidden in the archegoniophore or it may be entirely imbedded in the thallus. The capsule, containing spores and elaters, opens irregularly or splits into four valves at maturity.

LEAFY LIVERWORTS (HEPATOPHYTA)

The leafy liverworts are much more common than the thalloid ones. Their colour varies, different shades and combinations of green, yellow, red and brown being the most common. The gametophyte is usually about 0.3-0.8 cm wide by 1-5 cm long and is generally prostrate and flattened in habit. It usually possesses two rows of large leaves, one on each side of the stem (Fig. 2: 3), and a third row of small leaves (**amphigastria**) on the undersurface of the stem. Leaf arrangement may be **transverse**, **incubous**, or more commonly, **succubous**. The leaves are unlobed or varously lobed and divided. Sometimes each lateral leaf is tightly folded, with one lobe remaining smaller than the other (**complicate-bilobed**). The margins may be entire, toothed, or fringed with hairs (**cilia**). The leaves lack a costa and are usually of one layer of cells. Unicellular rhizoids are often present, either scattered on the ventral surface of the stem or restricted to specific parts of the stem or leaves. Yellow, brown, green or red gemmae are frequently present, commonly appearing as granules on leaf margins. The plants are unisexual or bisexual. Antheridia are borne on the sides of the stems surrounded by leaves, while the archegonia are commonly produced at the stem apices or sometimes on short lateral branches (Porella and Chiloscyphus) and are frequently surrounded by a leafy sheath, the **perianth**. The sporophyte usually has a long colourless seta that elevates the brown to black, spherical or cylindrical capsule above the perianth. The capsule contains spores and elaters, and usually opens by four valves. The sporophyte lasts only a short time and soon dries up after releasing the spores, all of which are shed as soon as the capsule matures.

MOSSES (BRYOPHYTA)

The mosses have the greatest number of species of all the bryophytes and, as a result, present considerable morphological diversity in both the gametophyte and sporophyte. All mosses (Fig. 2: 4) have a leafy gametophyte, either erect or prostrate, but in some the leaves are scarcely evident. The majority are assorted shades of green but some shades of yellow, red and brown are present in many. Some plants, especially those growing on rock in dry habitats, may even be black. The gametophytes are mostly 1-15 cm long but they are known to be much shorter (1 mm) and longer (60 cm). The stems are either simple or branched, with the branches sometimes being so numerous that they give the stems a "feathery" appearance. The leaves are in three to five spiral rows, or rarely in two opposite rows, and usually possess a single or double costa of varying length. They are generally unistratose except in the costa region where many layers of cells occur. Sometimes they are covered with longitudinal flaps or **lamellae**. The leaf shape varies, with linear, lanceolate and ovate probably being the most common. The leaves of mosses are rarely deeply notched, lobed or dissected like those of the leafy liverworts. However, they can be consistently curved and twisted in various ways and their surfaces may have folds and undulations. The margins can be entire or toothed. The stems of some species, especially those of branched mosses growing prostrate, have numerous, greenish, filamentous structures among the leaves called **paraphyllia**. Multicellular, reddish brown to whitish rhizoids are nearly always present at the base of the stems, on the surface of the stems growing adjacent to the substratum, or restricted to certain sites on the stems and leaves. Vegetative reproductive bodies, in the form of small, somewhat terete branches or yellowish green gemmae, either in small, leafy cups or on naked stalks, are sometimes evident in a few species treated in this guide. The gametophytes are either unisexual or bisexual. The inflorescences are visible as tiny buds at the apices of stems and short lateral branches or along the sides of stems. The sporophyte is a persistent and long-lived structure, compared to the sporophyte of the liverworts. In most mosses the sporophyte is made up of a slender, elongate seta which terminates in an urn-shaped capsule containing spores. The colour varies, with yellow, brown, orange, red and reddish brown being the most common. Covering the apex of the capsule is a thin, whitish, yellowish or brownish calyptra that is smooth or sometimes hairy. Beneath this is a convex to beaked lid, the **operculum**, over the mouth of the capsule. A ring of cells beneath the operculum, the **annulus**, aids in releasing the


COL
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4
CAP
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P
LF
SM
R
3

FIGURE 2. Structure of bryophytes. 1. Hornwort. 2. Thalloid liverwort. 3. Leafy liverwort. 4. Moss. (AN - annulus; C - costa; CAL - calyptra; CAP - capsule; COL - columella; IN - involucre; LF - leaf; N - neck; NC - *Nostoc* colony; OP - operculum; P - perianth; PER - peristome; R - rhizoids; S - seta; SM - stem; T - thallus; U - urn; V - valve).

operculum from the capsule, but usually it is too small to be seen at low magnification. The mouth of the capsule often is ringed by one or two rows of filamentous to lance-shaped teeth, collectively called the **peristome**. The peristome teeth are yellow, brown or red and they are always in some multiple of four, from 4-64, with one or two rows of 16 being the most common. Changes in humidity can cause them to twist or bend and thus assist with spore dispersal. Some mosses have no peristome teeth (e.g., Sphagnum) while others have neither a peristome not an operculum, the capsule opening instead by valves (e.g., Andreaea) somewhat like the liverworts. In most mosses the spores are shed over an extended period, and are extracted from the capsule by movement of the peristome teeth.

The mosses may be conveniently divided into two main groups, according to their growth habit and origin of the sporophyte. The **acrocarpous** mosses generally have erect, simple or sparsely branched gametophytes that grow in tufts and produce sporophytes at the tip of a stem or main branch. The **pleurocarpous** mosses usually have prostrate, freely branched gametophytes that grow in mats and produce sporophytes laterally from the main stem.

COLLECTING AND PREPARING A REFERENCE COLLECTION

Bryophytes can be found in a wide variety of moist, shady habitats in eastern Canada. They are water-loving plants because they are so poorly equipped to obtain and retain water and also because they require water for sexual reproduction. For these reasons they commonly grow on forest floors, on boulders in streams and brooks, beside lakes and waterfalls and in dense masses in swamps, fens and bogs. When they do grow in somewhat arid regions they always occur in a microhabitat where they can obtain the maximum amount of moisture. They avoid salt water except for a few species that always occur in the spray zone beside the ocean (e.g., Schistidium maritimum). Most species grow on soil, rock, trees, rotting wood and humus, though occasionally some species grow on such bizarre substrata as animal remains.

A 10-20x hand-lens is essential for field work in order to see the minute detail of the bryophytes. Several plants of each species should be removed from the substratum with the fingers or a knife. Plants containing an excessive amount of water should be squeezed out. Mosses in dense tufts should be divided into small groups so that they will dry faster. Plants bearing mature sporophytes should be collected whenever possible. Both male and female plants should be collected when unisexual species are encountered. Each bryophyte collection is put into a prefolded newspaper packet made from one-half of a page (Fig. 3) and the substratum recorded on the outside of the packet with a felt tip marking pen or some other permanent type of marker that will not smear when wet. The locality is also recorded on each packet, usually with a code number. The locality information, including the province, county or district, distance to nearest town, longitude and latitude, the date and any ecological information, such as exposure, moisture, surrounding vegetation (e.g., beech-maple woods), should be recorded in a field book. All collections from one locality are kept together in a collecting bag (cloth or plastic). Small paper sacks (2 lb.) may be used instead of newspaper packets but the plants often clump-up inside and take longer to dry. Upon returning home or to a field camp the bryophytes should be prepared for rapid drying to prevent the growth of mold and to preserve the colour. The newspaper absorbs much of the moisture from the plants. Any packets that are thoroughly wet or torn should be replaced. Approximately 30-50 packets are then placed in a fish-net bag (cotton decorative netting is the best and least expensive) and hung up to dry. The packets should be tumbled in the bag every few hours to facilitate drying. If a dry indoor room is available, the packets can simply be unfolded and spread out on the floor instead of using the bag method.

After the specimens are dry they are put into permanent packets for a reference collection. Packets are folded from sheets of white paper (21.5 x 28 cm) of good quality (50-100% rag content with 20-24 lb. weight) resulting in a standard size of about 10 x 14.5 cm (Fig. 4). The bryophytes should be further cleaned and trimmed of excess substratum so they will fit into the packet. A smaller packet may be folded for small plants or loose parts and placed inside the standard packet. Each collection is given a separate number. The name of the bryophyte and the collecting data are put on the packet's flap or a separate label slightly smaller than the flap onto which it is to be pasted (Fig. 5). The label should bear the following information: name(s) of bryophyte(s) with author(s), country

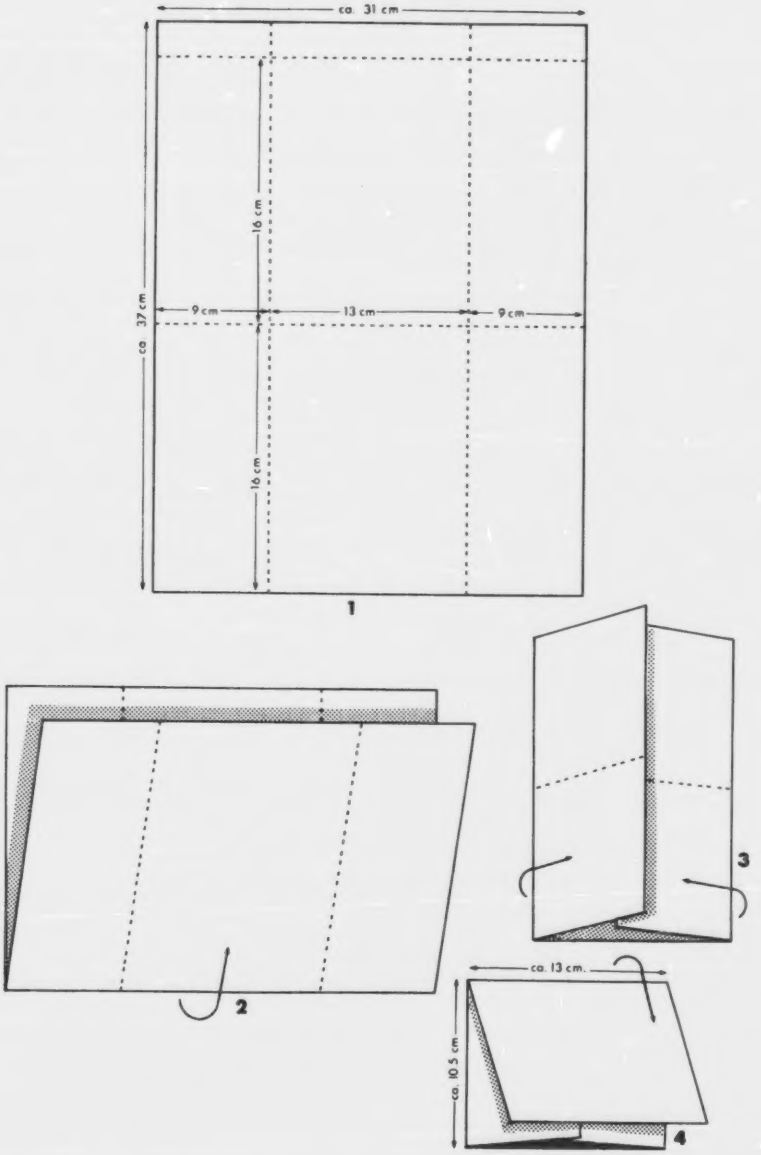
ca. 31 cm
16 cm
ca. 37 cm
9 cm
13 cm
9 cm
16 cm
1
2
3
ca. 13 cm.
ca. 10.5 cm
4

FIGURE 3. Newspaper packet for field collections.

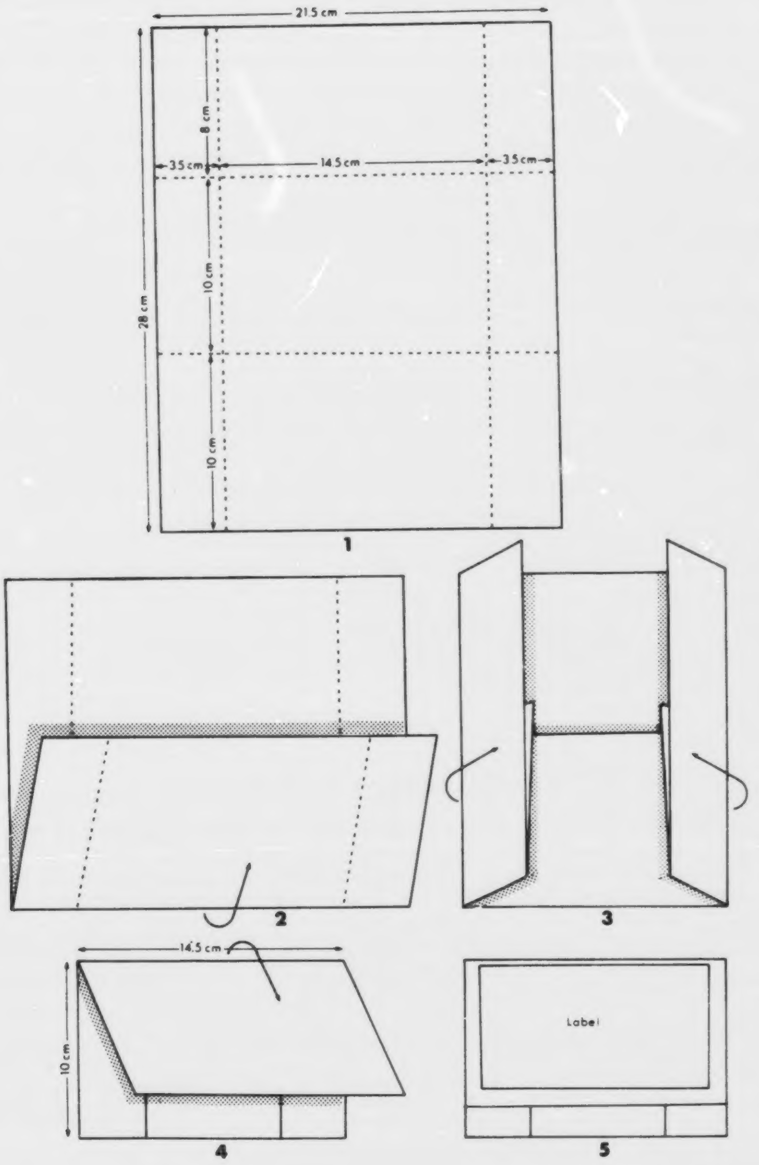
21.5 cm
8 cm
3.5 cm
14.5 cm
3.5 cm
28 cm
10 cm
10 cm
1
2
3
14.5 cm
10 cm
Label
4
5

FIGURE 4. Specimen packet for reference collection.

BRYOPHYTES OF NOVA SCOTIA

Grimmia maritima Turn.

In crevices of shale bluff beside ocean.

DIGBY COUNTY: Meteghan Provincial Picnic Park,
about 1 km south of Meteghan, ca. 44°11' N, 66°10'W.

R.R.Ireland,No.12408 1 August 1968

National Herbarium of Canada

FIGURE 5. Label for specimen packet.

(optional), province, county or district, locality (including kilometers to nearest town, longitude and latitude), habitat (including substratum), date collected, collector, collection number, person who identified specimen if different from collector, and year identified. The specimens may then be conveniently stored in shoe boxes for future reference.

IDENTIFICATION AND METHODS OF STUDY

To identify a bryophyte, a dried plant is removed from its packet and revived to its original appearance by soaking it in a small dish of water for a minute or so. A 10-20% solution of household liquid detergent may be used to speed up the wetting process. The plant may then be examined by placing it on a microscope slide or on a thin piece of clean glass about 8 cm square. A dissecting microscope with magnification up to 25 or 50x and with a transmitted light base is ideal for studying the superficial features of bryophytes. However, if a microscope is not available, a 10-20x hand-lens may be substituted with a certain degree of success. The only other equipment required is two dissecting needles, tweezers and a metric ruler.

Hornworts and liverworts are best observed without being dissected, but mosses often need to have some leaves removed from the stem in order to look for a costa, teeth on the margins, alar cells or other important features. Only leaves from about the middle third of the stem should be removed since they are the most mature and fully developed. Leaves of large mosses may be removed with tweezers by pulling downward and away from the stem apex in order to get the entire leaf with the alar cells intact. The leaves of small mosses are easier to remove by using two dissecting needles. One needle is used to hold the plant down while the other is used to scrape off the leaves, always scraping from the stem apex toward the base.

When it is necessary to remove the operculum of a moss capsule to look at the peristome teeth, a small hole should be made in the capsule wall before soaking the capsule so the water can enter faster. A firmly attached operculum may eventually have to be forced off with dissecting needles and in this case the teeth may remain inside the operculum.

Thalloid liverworts are most easily studied from freshly collected material. Observations of the nature of the scales, air chambers and colour should be noted for each collection so that this information is available when the specimen is to be determined.

The techniques used to study the leafy liverworts are generally the same as for the mosses. Observations should be made on the most typical leaves of the plant which are near the middle third of the stem. The three types of leaf insertion (the line at which the leaf joins the stem), transverse, succubous and incubous, are important features used to distinguish the genera. When determining the type of leaf insertion it is important to observe the plant from above (i.e., looking down on the dorsal surface) with the stem spex pointing away from the observer. The presence of underleaves and rhizoids will aid in distinguishing the ventral surface.

REFERENCE BOOKS

Listed below are a few illustrated books that the beginner may find useful when identifying bryophytes of eastern Canada.

Conard, H.S. 1979. How to Know the Mosses and Liverworts. Second edition. Revised by P.L. Redfearn, Jr. 302 pp. Includes hornworts, liverworts and mosses. Available from W.C. Brown Company Publishers, 135 South Locust, Dubuque, Iowa 52001.

Crum, H.A. 1983. Mosses of the Great Lakes Forest. Third edition. 417 pp. Intended for identification of mosses of northern Michigan but it works well in our region. Available from University of Michigan, Ann Arbor, Michigan 48109.

Ireland, R.R. Moss Flora of the Maritime Provinces. 738 pp. Covers the mosses of New Brunswick, Nova Scotia and Prince Edward Island but it can be used to a great extent for the other eastern provinces. Available from McClelland and Stewart Limited, 25 Hollinger Road, Toronto, Ontario M4B 3G2.

Schuster, R.M. 1977. Boreal Hepaticae, a Manual of the Liverworts of Minnesota and Adjacent Regions. Bryophytorum Bibliotheca 11. 606 pp. (Reprint of the American Midland Naturalist 49(2): 257-684. 1953). Intended for the identification of hornworts and liverworts of eastern United States but it is also good for our region, although some of the names are outdated. Available from J. Cramer, FL-9490 Vaduz, Germany.

The advanced student will find the following books useful:

Crum, H.A. and L.E. Anderson. 1981. Mosses of Eastern North America. 2 Vols., 1328 pp. Available from Columbia University Press, 136 South Broadway, Irvington-on Hudson, New York 10533.

Schuster, R.M. 1966-79. The Hepaticae and Anthocerotae of North America East of the Hundredth Meridian. 4 Vols. (More to be published). Also available from Columbia University Press.

KEYS TO BRYOPHYTES

Use of Keys

The keys that follow may be used to determine the name of an unknown bryophyte. In each key there are always two identically numbered or lettered statements. The user should read both statements and select the one that more accurately fits the plant being identified. The leaders to the right of each statement indicate either a name, which is that of the bryophyte or group of bryophytes in the General Key, or another number or letter. If it is a number or letter, proceed to that number or letter and again make a choice, always selecting the statement that better describes the plant being identified. When a name is reached, indicating the identity of the bryophyte, the illustrations should be checked carefully to make certain they match the plant. Immediately following the scientific binomial is the name of the person(s), usually abbreviated, responsible for it. The distribution of each bryophyte is given first for eastern Canada, followed by its occurrence throughout North America. A two-letter abbreviation is used for the geographic localities which are listed near the end of the guide.

One word of caution is necessary. Since many of the 235 bryophytes contained in this guide resemble others from the region that are not included (ca. 520 additional species), it is possible to key out an excluded species to one that is contained in this treatment. Therefore, the identified specimen should be verified by a bryologist whenever possible. Robert R. Ireland is willing to verify specimens as long as he is contacted in advance and as long as large numbers of specimens are not sent.

GENERAL KEY TO THE GROUPS OF BRYOPHYTES

1. Plants thalloid...2

   2. Plants circular in outline or nearly so, thin, dark-green, without upper surface markings or costa; capsules long-cylindrical, lacking a seta, splitting into 2 valves, columella present......................I. Hornworts (Anthocerotophyta) (p. 21)

   2. Plants not usually circular, often thick, light- to dark-green, sometimes with upper surface markings and costa; capsules neither long-cylindrical nor splitting into 2 valves, usually with a seta, columella absent..............................II. Thalloid Liverworts (Hepatophyta) (p. 23)

1. Plants leafy...3

   3. Leafy plants with 2-3 ranks of leaves (one row on each side of stem and a third, if present, on underside of stem, midway between lateral leaves), the leaves usually round, lobed or deeply incised, costa lacking; capsules lacking operculum, eperistomate.......................................III. Leafy Liverworts (Hepatophyta) (p.37)

   3. Leafy plants (leaves not evident in _Buxbaumia_) usually with more than 2 ranks of leaves (2-ranked in _Fissidens_ and _Distichium_), the leaves rarely round, or, if so, never lobed or dissected, costa often present, single or double; capsules usually with operculum, peristomate or eperistomate...IV. Mosses (Bryophyta) (p. 78)

I. Key to Hornworts (Division Anthocerotophyta)

1. Capsules long, 1-3 cm, yellowish at maturity because of yellow spores..Phaeoceros laevis

   Phaeoceros laevis (L.) Prosk. **Fig. 6: 1-3**
   On moist soil or sometimes rock at edges of lakes, streams, ditches, paths and roads. NS, QU, ON--BC and throughout most of U.S.

1. Capsules short, .3-.8 cm, blackish at maturity because of black spores..Anthoceros macounii

   Anthoceros macounii M.H. Howe **Fig. 6: 4**
   On moist loam or clay banks. NS, QU--Southeastern Canada and adjacent U.S. to WI and MN.

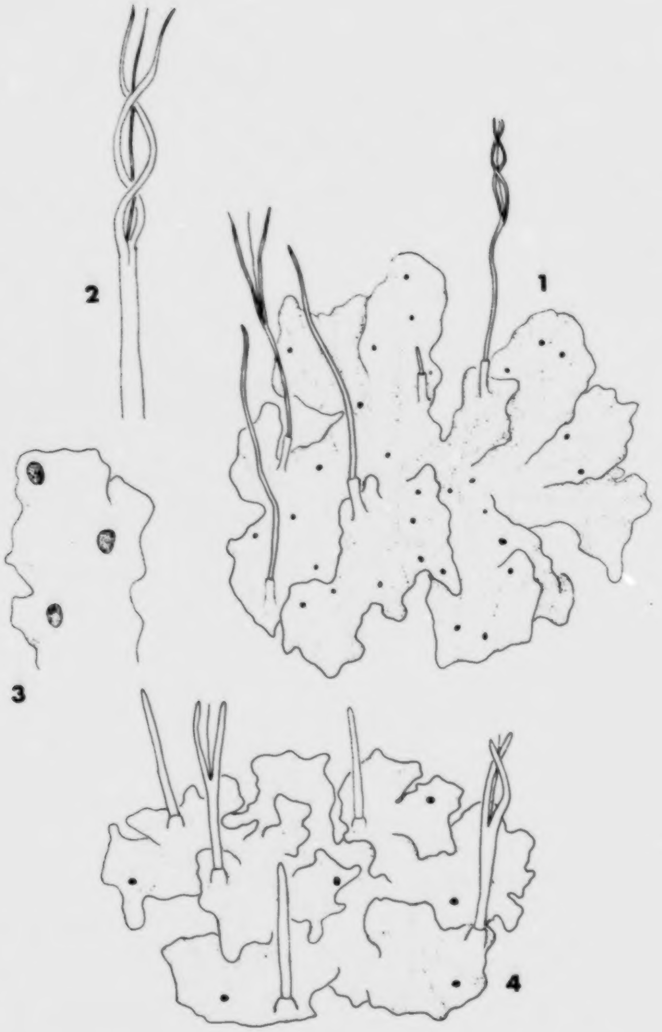

FIGURE 6. 1-3, **Phaeoceros laevis.** 1. Habit (x3). 2. Apex of sporophyte (x9). 3. Portion of thallus showing Nostoc colonies (x18). 4, **Anthoceros macounii.** 4. Habit (x7).

II. Key to Thalloid Liverworts (Division Hepatophyta)

1. Upper surface of thalli with pores and often with diamond-shaped markings.............................2

1. Upper surface of thalli with neither pores nor diamond-shaped markings.............................6

2. Thalli somewhat semicircular, upper surface with furrows; ventral surface with purple, lance-shaped, toothed scales; plants aquatic.............................Ricciocarpos natans

Ricciocarpos natans (L.) Corda **Fig. 7: 3-4**

Floating on surface of small ponds and quiet streams, or stranded on wet mucky soil. QU, ON, MB--QU to YT and BC, south to FL, AL, LA, TX, CO, MT, ID and CA.

2. Thalli neither semicircular nor with furrows; ventral surface lacking lance-shaped scales; plants not aquatic.............................3

3. Thalli small, usually less than 1 cm wide, margins usually purplish or reddish; diamond-shaped markings not visible with naked eye; gemmae cups lacking.............................4

3. Thalli large, often more than 1 cm wide, margins not purplish or reddish; diamond-shaped markings often visible with naked eye; gemmae cups sometimes present on dorsal surface of thallus.............................5

4. Thalli with diamond-shaped markings clearly visible with lens; cells around the pores raised; margins plane.............................Preissia quadrata

Preissia quadrata (Scop.) Nees **Fig. 8**

On soil over moist, calcareous shale and sandstone, sometimes in marly ditches. NF to ON--GR, throughout Canada and the northern U.S.

4. Thalli with diamond-shaped markings lacking or indistinct with lens; cells around the pores not noticeably raised; margins ascending or inrolled.............................Reboulia hemisphaerica

Reboulia hemisphaerica (L.) Raddi **Fig. 9**

(Purple-Margined Liverwort)

On dry rock or on soil over rock. NB to MB--NB to BC and throughout U.S.

5. Thalli with gemmae-cups on dorsal surface; nonaromatic even when crushed; male and female receptacles often present, stalked.............................Marchantia polymorpha

Marchantia polymorpha L. **Fig. 10**

(Common Liverwort)

On moist soil (nonorganic) in burned-over areas, sometimes in marly bogs. NF to MB--GR, throughout Canada and U.S.

5. Thalli lacking gemmae-cups; plants strongly aromatic, especially when crushed; male and female receptacles rarely present, the male sessile.............................Conocephalum conicum

Conocephalum conicum (L.) Lindb. **Fig. 11**

(Great Scented Liverwort)

On damp soil, rock, or rotten logs, primarily along streams. NF to MB--throughout most of Canada and U.S.

6. Thalli with costa and sometimes with small, dark spots (*Nostoc* colonies within the thallus)..........7
6. Thalli lacking costa or costa indistinct, without small, dark spots..........10

7. Thalli margins lobed..........8
7. Thalli margins not lobed (sometimes gemmae on margins of *Metzgeria* looking like small lobes)..........9

8. Thalli with small, dark spots (*Nostoc* colonies within the thallus) scattered along margin; flask-shaped gemmae receptacles often present near thalli apices..........*Blasia pusilla*

Blasia pusilla L. **Fig. 12**
On moist, denuded, loamy or clayey banks, ditches or paths. NF to MB--GR to MB, south to NC, MI and IA; in the West from AK to CA; also in NM.

8. Thalli lacking dark spots and gemmae receptacles..........*Pellia epiphylla*

Pellia epiphylla (L.) Corda **Fig. 13**
(Wide-Nerved Liverwort)
On shaded moist soil or rocks. NF to MB--LB to AK, south to GA, AL, TN, WI, MT, WY and WA.

9. Thalli large, 2 mm wide or more, lacking hairs on margin..........*Pallavicinia lyellii*

Pallavicinia lyellii (Hook.) Carruth. **Fig. 14**
On decaying wood, rocks and soil in bogs and swampy places. NF, NB, NS, QU, ON--NF to ON, south to FL, AL and TX.

9. Thalli small, usually less than 2 mm wide, hairs on margin..........*Metzgeria*

METZGERIA

A. Thalli with some marginal hairs in groups of two, ventral surface with hairs only on costa; gemmae lacking on margins of thalli..........*M. conjugata*

Metzgeria conjugata Lindb. **Fig. 15: 1-3**
On moist shaded rocks, sometimes on trunks of trees. NS, QU, ON--NS to ON, south to FL, TN, MI and WI; in the West from AK to CA; also in NM.

A. Thalli always with marginal hairs single, ventral surface with hairs scattered throughout; multicellular gemmae common on margins of thalli..........*M. furcata*

Metzgeria furcata (L.) Dum. **Fig. 15: 4-6**
On shaded cliff faces and ledges, occasionally on bases of trees. NF, NB, NS, QU--NF to MI, south to GA and TN.

10. Thalli thin and translucent, individual cells often evident, dichotomously branched..........11
10. Thalli thick and individual cells not evident, irregularly branched..........12

11. Thalli narrow, 1-2 mm wide; plants usually aquatic, submerged..*Riccia* *fluitans*

Riccia fluitans L. **Fig. 7: 1-2**
(Floating Crystalwort)
Floating just beneath the surface in water of quiet streams or ponds, sometimes stranded on mud when water recedes. QU, ON, MB--QU to BC, south throughout most of U.S.

11. Thalli broad, 3 mm or more in width; plants terrestrial.................. ....*Pellia* *epiphylla* (See p. 24)

12. Thalli sparingly branched, broad, 3 mm or more in width...*Aneura* *pinguis*

Aneura pinguis (L.) Dum. **Fig. 16: 1**
Predominantly a calciphile occurring in swamps, ditches and on thin soil over limestone or basalt but sometimes on rotten logs and stumps. NF, NS, QU, ON, MB--GR to AK, south throughout U.S.

12. Thalli much branched, narrow, less than 3 mm wide........................*Riccardia*

RICCARDIA

A. Thalli 2-3 pinnately branched; occurring in calcareous sites..*R*. *multifida*

Riccardia multifida (L.) S. Gray **Fig. 16: 2**
On wet ground in bogs and swamps, sometimes on wet rocks and rotten logs. NF, NS, QU, ON--GR to ON, south to FL, TN, MI and WI; in the West from AK to AT, south to CA and ID.

A. Thalli irregularly branched or sometimes bipinnately branched; occurring in noncalcareous sites...B

B. Thalli branches usually broadened near apex...*R*. *latifrons*

Riccardia latifrons Lindb. **Fig. 17: 1**
On decaying wood in moist woods or swamps. NF to ON--NF to ON, south to FL, AL, TN, MI and WI; in the West from AK to AT, south to CA, ID and WY.

B. Thalli branches narrowed toward apex...........................*R*. *palmata*

Riccardia palmata (Hedw.) Carruth. **Fig. 17: 2**
On decaying, moist logs or sometimes on peaty banks. NB, NS, QU, ON--NS to ON, south to FL, TN and AR; in the West from AK to CA and ID.

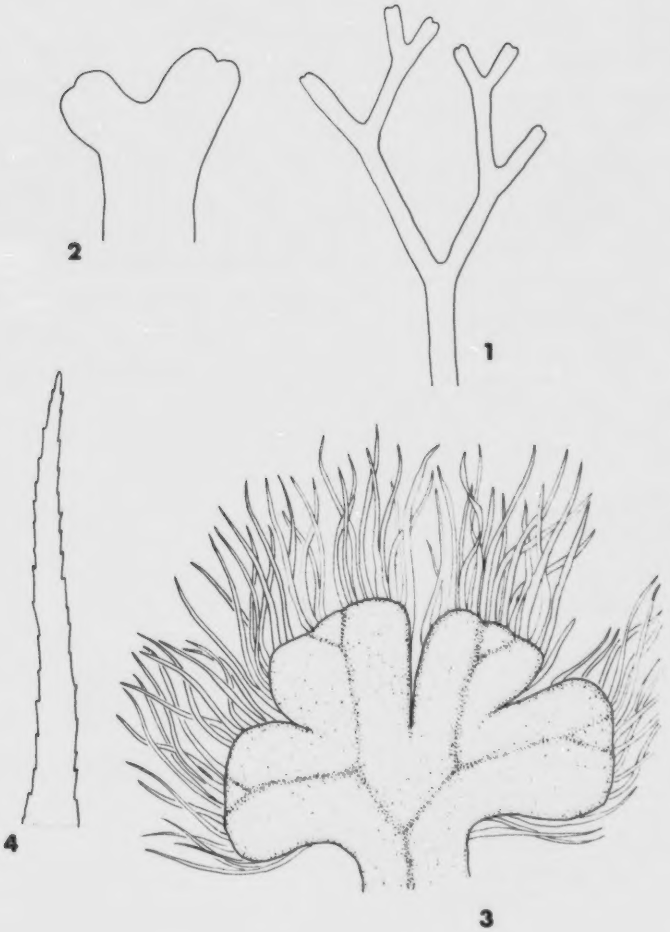

FIGURE 7. 1-2, **Riccia fluitans**. 1. Habit (x9). 2. Apex of thallus (x36). 3-4, **Ricciocarpos natans**. 3. Habit (x7). 4. Ventral scale from thallus (x15).

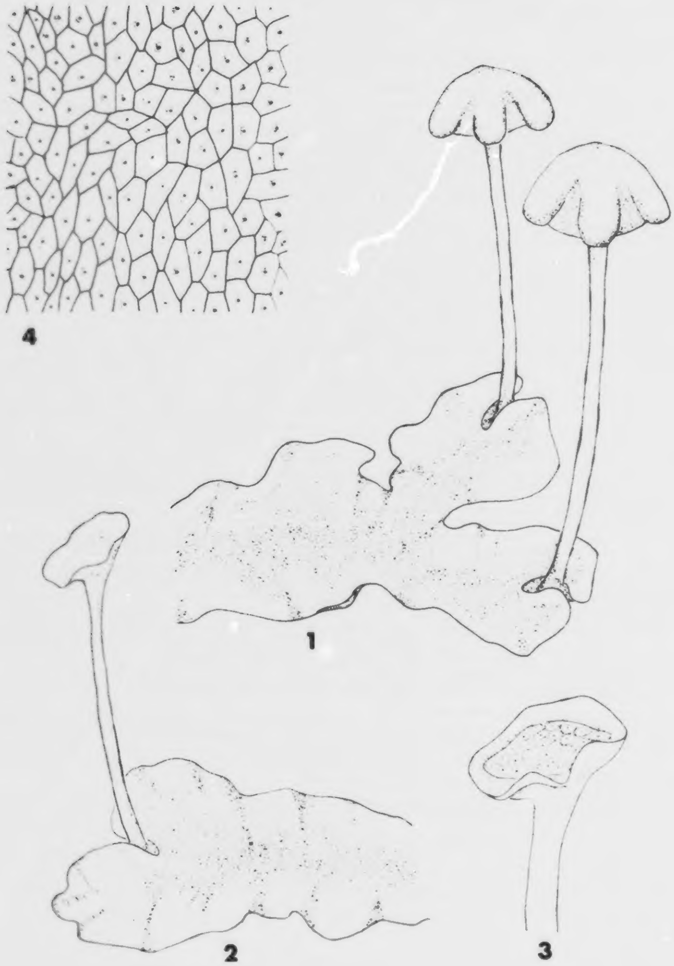

FIGURE 8. 1-4, **Preissia quadrata.** 1. Habit of female plant with receptacle (x4). 2. Habit of male plant with receptacle (x4). 3. Male receptacle (x7). 4. Portion of dorsal surface of thallus showing markings and pores (x18).

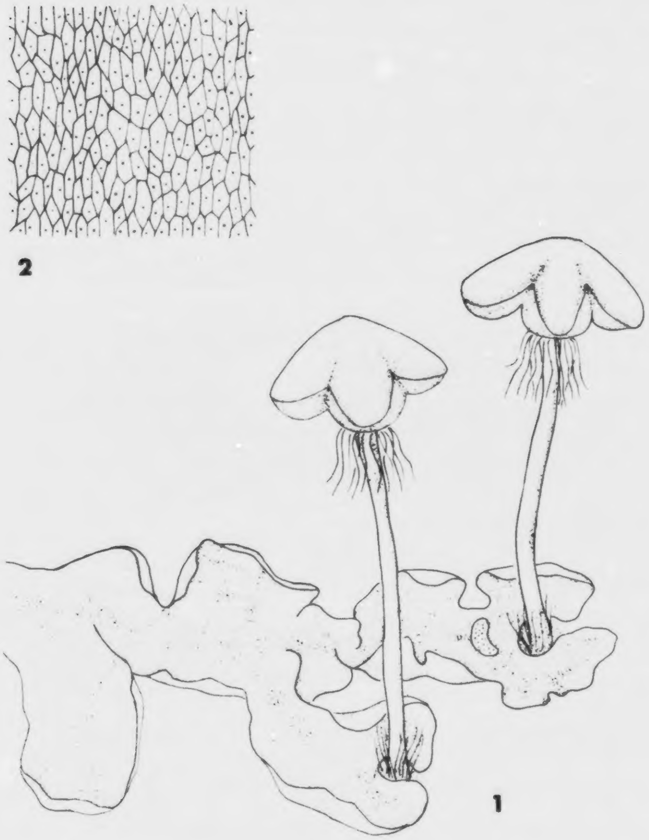

FIGURE 9. 1-2, **Reboulia hemisphaerica.** 1. Habit of plant with female receptacles and sessile, kidney-shaped male receptacle on thallus near base of female receptacle (x9). 2. Portion of dorsal surface of thallus showing markings and pores (x36).

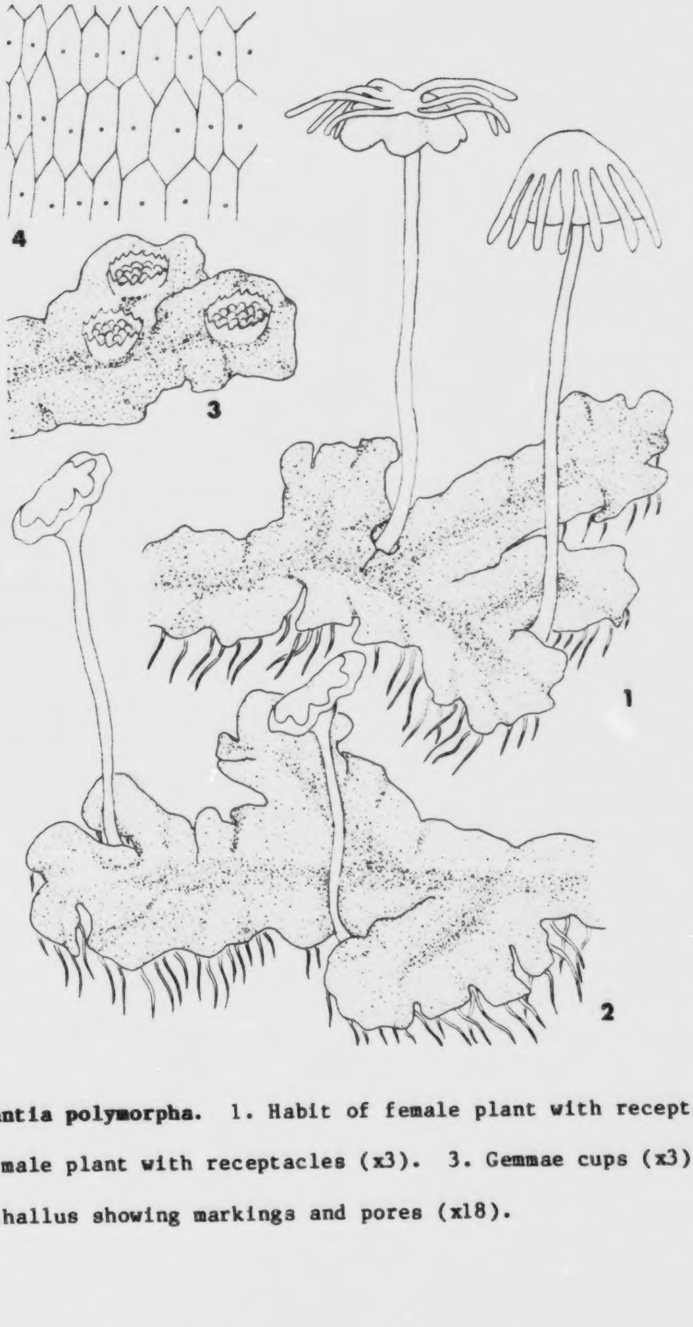

FIGURE 10. 1-4, **Marchantia polymorpha.** 1. Habit of female plant with receptacles (x3). 2. Habit of male plant with receptacles (x3). 3. Gemmae cups (x3). 4. Dorsal surface of thallus showing markings and pores (x18).

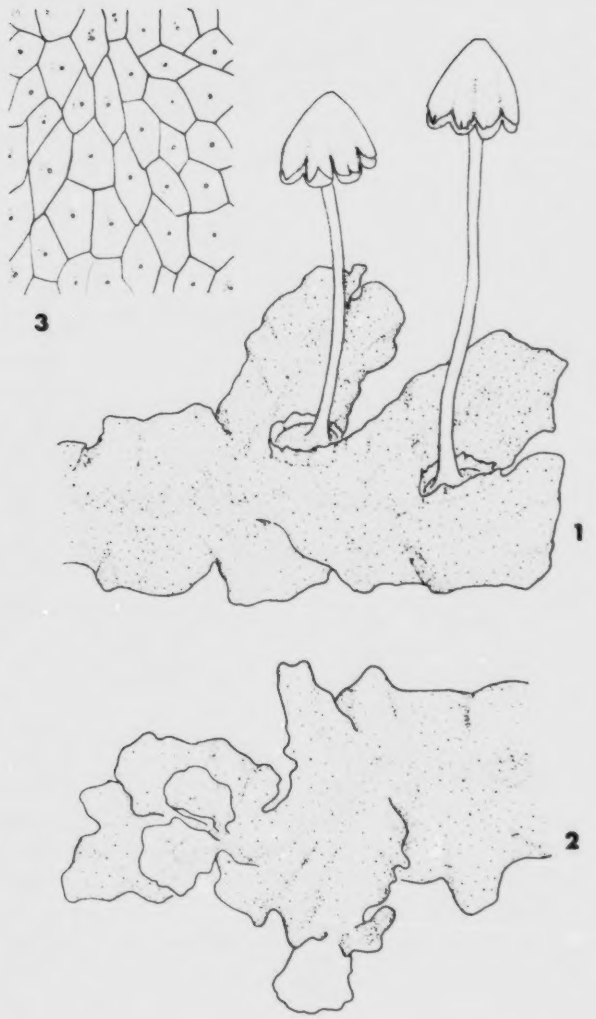

FIGURE 11. 1-3, **Conocephalum conicum**. 1. Habit of female plant with receptacles (x3). 2. Habit of male plant with sessile receptacles (x3). 3. Dorsal surface of thallus showing markings and pores (x18).

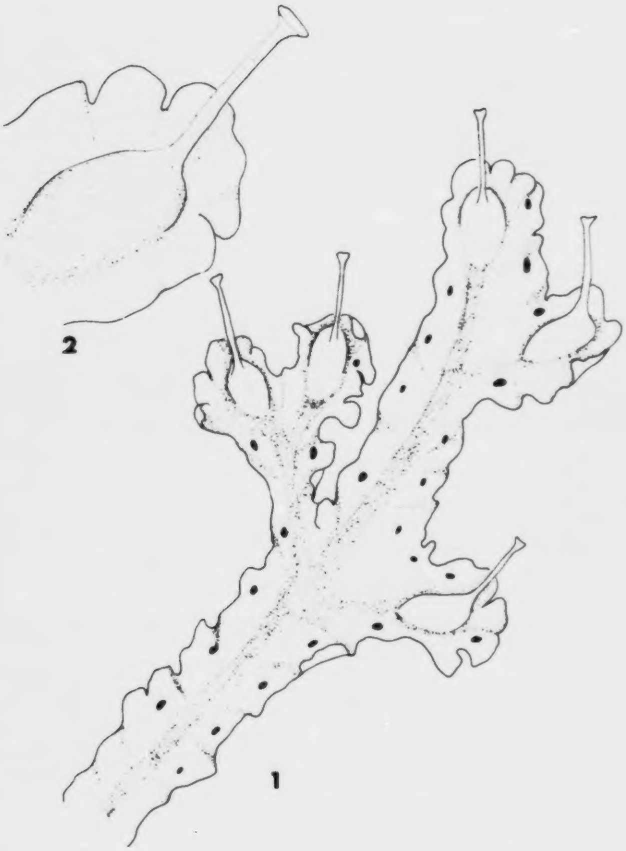

FIGURE 12. 1-2, **Blasia pusilla.** 1. Habit of plant with gemmae receptacles (x4). 2. Gemmae receptacle (x12).

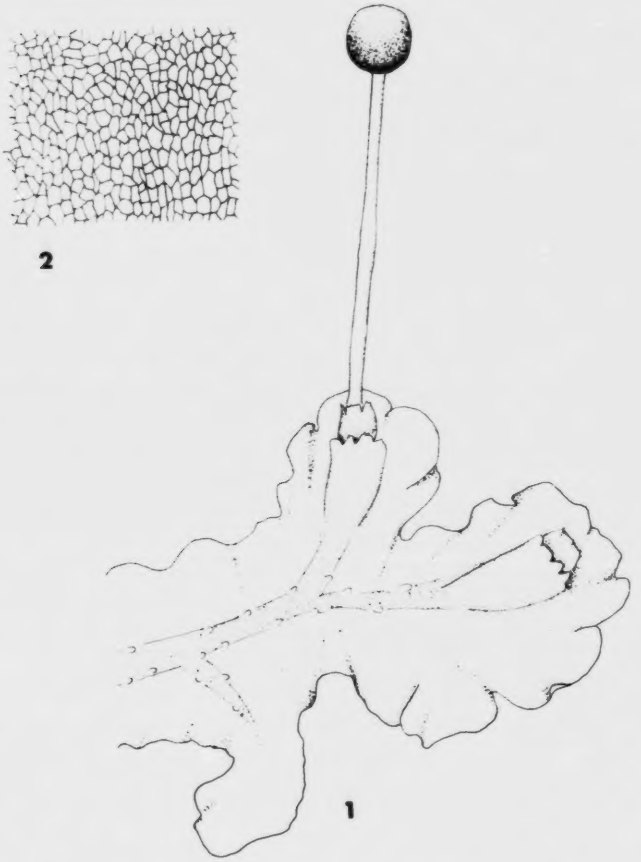

FIGURE 13. 1-2, **Pellia epiphylla.** 1. Habit of plant with sporophyte and small antheridial protuberances (x4). 2. Dorsal surface of thallus showing markings (x36).

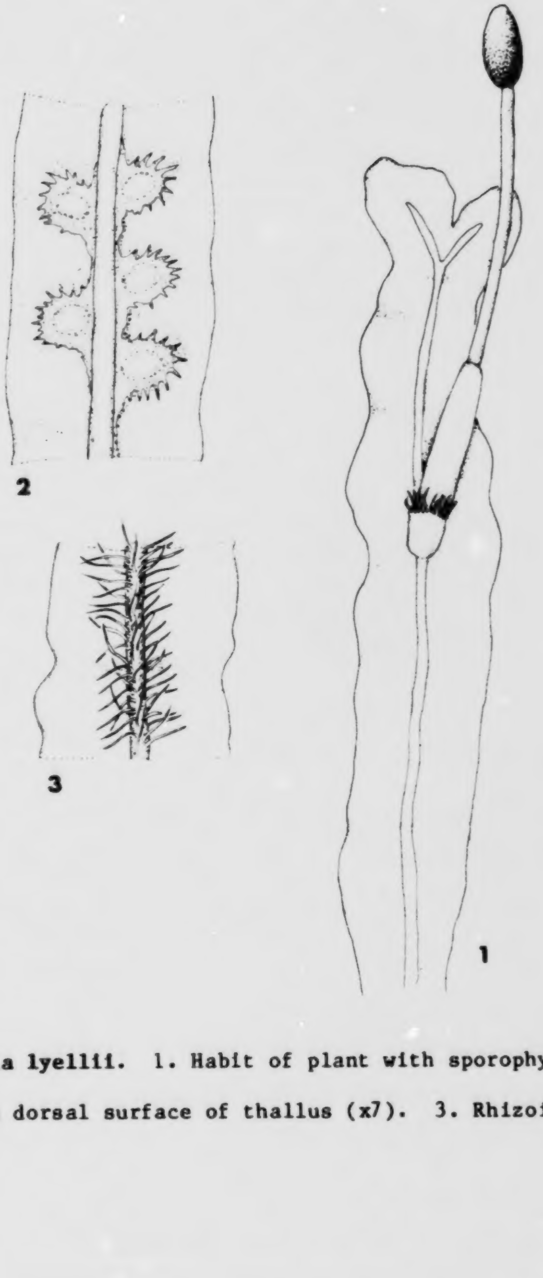

FIGURE 14. 1-3, **Pallavicinia lyellii.** 1. Habit of plant with sporophyte (x4). 2. Antheridial scales on dorsal surface of thallus (x7). 3. Rhizoids on ventral surface of costa (x7).

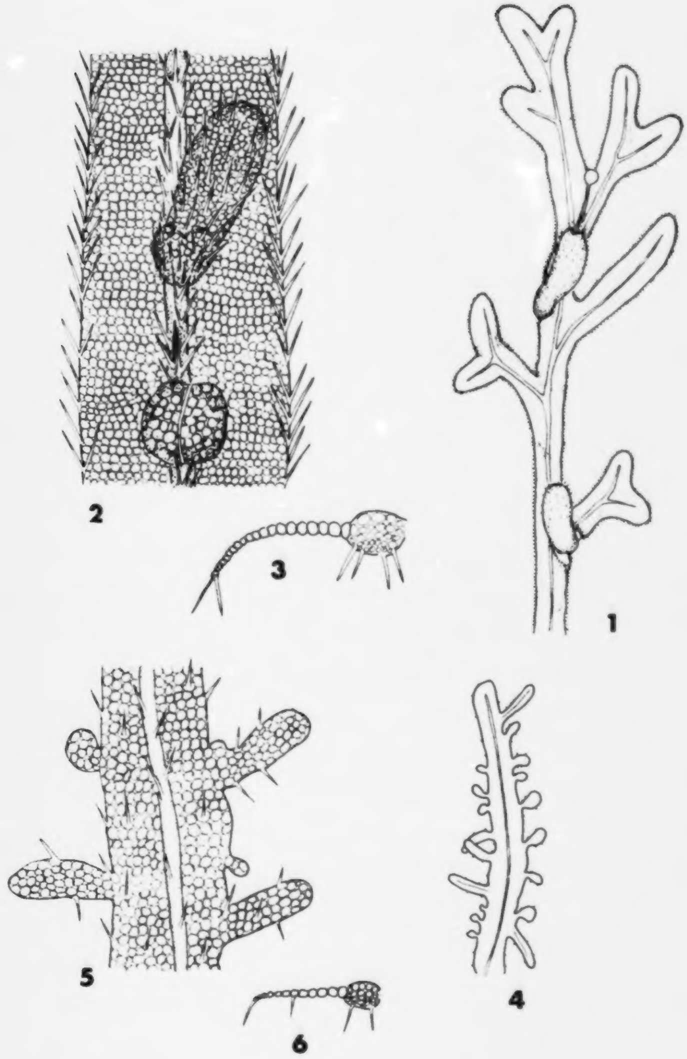

FIGURE 15. 1-3, **Metzgeria conjugata.** 1. Habit of plant in dorsal view showing sporophytes (x9). 2. Ventral surface of thallus showing perichaetial branch with developing calyptra (hairy) and antheridial branch below (x36). 3. Thallus in cross-section (x36). 4-6, **Metzgeria furcata.** 4. Habit of plant with marginal gemmae (x9). 5. Ventral surface of thallus (x36). 6. Thallus in cross-section (x36).

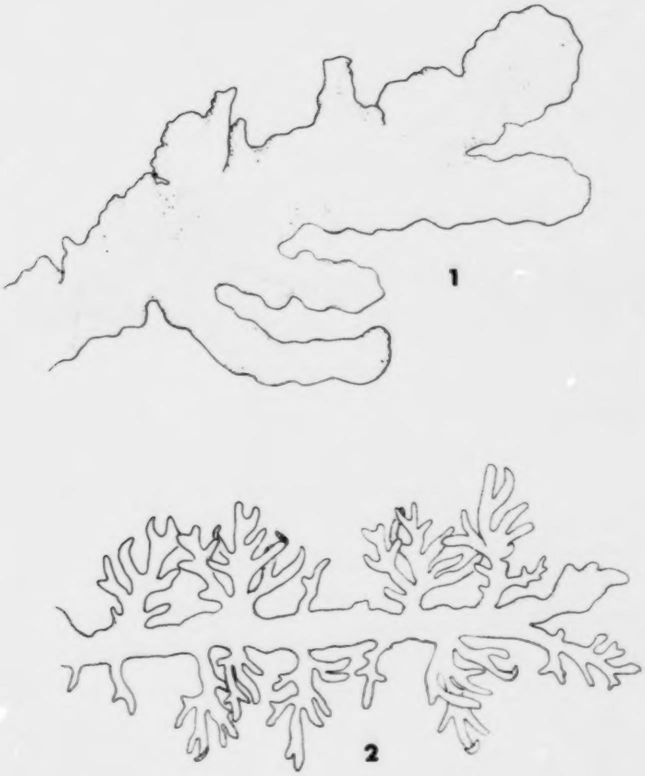

FIGURE 16. 1, **Aneura pinguis**. 1. Habit (x3). 2, **Riccardia multifida**. 2. Habit (x9).

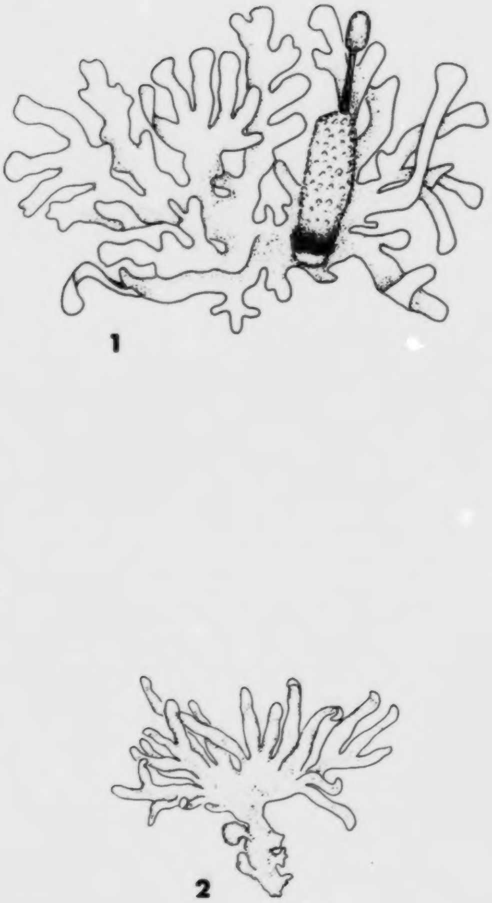

FIGURE 17. 1, **Riccardia latifrons.** 1. Habit of plant with sporophyte (x9). 2, **Riccardia palmata.** 2. Habit (x9).

III. Key to Leafy Liverworts (Division Hepatophyta)

1. Leaves divided into filaments or having margins with many long cilia........2

1. Leaves neither filamentous nor with numerous cilia on margins, entire or broadly lobed, sometimes the lobes ending in a cilium or the leaf base with a few cilia........4

2. Plants small, stems less than 1 mm wide, irregularly branched, leaves divided to base into 3-4 filamentous lobes........Blepharostoma trichophyllum

Blepharostoma trichophyllum (L.) Dum. **Fig. 18: 1-2**

On moist decaying logs, damp, shaded rock faces and sometimes on bases of trees. NF to MB--GR to AK, south in the mountains and northern states to NC, TN, MI, IL, IA, NM, MT, ID and CA.

2. Plants large, stems usually more than 1 mm wide, pinnately branched, leaves divided into 2-5 lobes, the margins ciliate........3

3. Plants light yellowish- or whitish-green, plumose, usually over 1 cm wide, leaves with narrow lobes with branched cilia........Trichocolea tomentella

Trichocolea tomentella (Ehrh.) Dum. **Fig. 18: 3-4**
(Woolly Liverwort)

On rocks, soil and rotten logs, predominantly in cedar swamps, but also in rather shady, moist sites, especially beside creeks and waterfalls. NF to ON--NF to ON, south to FL, TN, AR and WI.

3. Plants green to reddish- or purplish-brown, usually not plumose, less than 1 cm wide, leaves with broad lobes with unbranched cilia........Ptilidium

PTILIDIUM

A. Leaves divided 1/2 their length into wide lobes, the margins with short cilia; plants green to reddish brown........P. ciliare

Ptilidium ciliare (L.) Hampe **Fig. 19: 1-3**

On thin soil or humus over exposed rock, occasionally in depressions in bogs. NF to MB--GR to AK, south throughout Canada and to CT, MI, IN, WI and MN; also in MT.

A. Leaves divided 3/4 or more their length into narrow lobes, the margins with long cilia; plants green to yellowish brown........P. pulcherrimum

Ptilidium pulcherrimum (G. Web.) Hampe **Fig. 19: 4-6**

On bark, at bases of trees, on rotting logs and on rock. NF to MB--NF to AK, south to NC, TN, OH, MI, WI, IA, MB, MT, ID and WA.

4. Leaves complicate-bilobed........5

4. Leaves undivided or lobed but not complicate-bilobed........10

5. Leaves with the dorsal lobe smaller than the ventral lobe..............................6
5. Leaves with the dorsal lobe larger than the ventral lobe...............................7

6. Leaf lobes narrowly elongate (lingulate), the ventral lobe 2-3 times as long as wide..*Diplophyllum*

DIPLOPHYLLUM

A. Leaves with a vitta extending almost to apex....................*D. albicans*

Diplophyllum albicans (L.) Dum. **Fig. 20: 1-2**

Usually on shaded, moist, noncalcareous rocks beside streams, occasionally on rotten wood. NF, NB, NS, QU--GR and NF, south to NS and ME; in the West from AK to YT, south to OR.

A. Leaves lacking vitta...B

B. Leaf apices apiculate......................................*D. apiculatum*

Note - May be confused with *Scapania umbrosa* but that species has decurrent ventral leaf lobes while *D. apiculatum* does not.

Diplophyllum apiculatum (Evans) Steph. **Fig. 20: 3-4**

On moist soil banks, sometimes on wet rocks near streams. NB, NS, ON--NS to ON, south to GA, TN, AR and OK.

B. Leaf apices obtuse...*D. taxifolium*

Diplophyllum taxifolium (Wahlenb.) Dum. **Fig. 20: 5-6**

On shaded, noncalcareous rock outcrops in humid regions. NF, NB, NS, QU, ON, MB--GR to MB, south in the mountains and northern states to NC, TN and MN; in the West from AK to YT, south to CA, ID and MT.

6. Leaf lobes subcircular to broadly ovate, the ventral lobe 1-2 times as long as wide.......................................*Scapania*

SCAPANIA

A. Ventral leaf lobes rounded at apices, the lobes nearly as wide as long..B
A. Ventral leaf lobes acute at apices, the lobes as wide as long or much longer than wide.................................E

B. Ventral leaf lobes not decurrent; leaf margins entire or nearly so...................................*S. irrigua*

Scapania irrigua (Nees) Gott. *et al.* **Fig. 21: 1-4**

In or around standing water in bogs, at margins of lakes and sunny rock pools. NF to MB--GR to MB, south to NJ, PA, MI, WI and MN; in the West from AK to YT, south to CA, MT and CO.

B. Ventral leaf lobes distinctly decurrent; leaf margins dentate to spinose-ciliate, rarely entire..C

C. Keel of leaves strongly curved; leaf margins entire to weakly dentate; gemmae lacking........................S. paludosa

Scapania paludosa (K. Müll.) K. Müll. **Fig. 21: 5-8**
On rocks in and beside streams or in springy areas of acid bogs. NF, QU, ON--GR to ON, south to ME and MA; in the West from AK to AT, south to CA and MT.

C. Keel of leaves straight to slightly curved; leaf margins strongly dentate to spinose-ciliate, rarely entire; gemmae often present.............................D

D. Stems usually black at maturity; dorsal leaf lobes not decurrent; leaf margins dentate to strongly serrate, rarely entire; gemmae green to yellowish green...S. undulata

Scapania undulata (L.) Dum. **Fig. 22: 1-4**
On acidic rocks in streams or creeks, occasionally on sandy or loamy banks or damp sandstone away from water but in areas of high humidity. NF to MB--GR to MB, south to GA, TN, MI, WI and MN; in the West from AK to YT, south to CA, AZ and NM.

D. Stems green to dark brown or red at maturity rarely black; dorsal leaf lobes distinctly decurrent; leaf margins spinose-ciliate, sometimes dentate; gemmae cinnamon brown.....................S. nemorosa

Scapania nemorosa (L.) Dum. **Fig. 22: 5-8**
On shady, seepy cliffs or ledges, rocks near waterfalls, clayey or loamy soil along paths or banks of streams, occasionally on moist decaying logs. NF to ON--LB to ON, south to FL, AL, MS, LA and TX.

E. Large plants, usually over 1 cm long; ventral leaf lobes about as wide as long; leaf margins entire or nearly so..F

E. Small plants, seldom reaching 1 cm long; ventral leaf lobes much longer than wide; leaf margins entire or coarsely and irregularly serrate...G

F. Keel of leaves straight or slightly curved; gemmae green to yellowish green..S. irrigua (See p. 38)

F. Keel of leaves strongly curved; gemmae reddish to reddish brown...................................S. paludicola

Scapania paludicola Loeske & K. Müll. **Fig. 23: 1-3**
In bogs and swamps. NF, NB, NS, QU, ON, MB--GR to MB, south to CT, NY, MI, WI and MN; also in AK to BC.

G. Leaf margins coarsely and irregularly serrate.....................S. umbrosa
Note - Sometimes similar to Diplophyllum apiculatum but that species has nondecurrent ventral leaf lobes while S. umbrosa has decurrent lobes.

Scapania umbrosa (Schrad.) Dum. **Fig. 23: 4-6**
On moist decaying logs or moist rocks near water. NF, NB, NS, QU, ON--LB to ON, south to ME, NH, NY and WI; in the West from AK and BC, south to CA, ID and MT.

G. Leaf margins entire..H

H. Leaves dorsally secund, especially when dry, dorsal lobes ca. 1/4 the size of the ventral lobes; gemmae brown to reddish brown..S. gymnostomophila

Scapania gymnostomophila Kaal. **Fig. 24: 1-3**

A calciphile occurring on wet rocks near water. NF, NS, QU, ON--GR to ON, south to MA, NY, MI, WI and MN; in the West from AK to YT, south to BC and ID.

H. Leaves not dorsally secund, dorsal lobes ca. 1/2 the size of the ventral lobes; gemmae green to yellowish green..............................S. mucronata

Scapania mucronata Buch **Fig. 24: 4-6**

On soil on acidic or calcareous cliffs and ledges. NF, NB, NS, QU, ON--GR to ON, south in the mountains and northern states to MA, NC, MI, WI and MN; in the West from AK to YT, south to OR and CO.

7. Stems without row of underleaves..................................Radula complanata

Radula complanata (L.) Dum. **Fig. 25: 1-4**

On shaded, damp rock (mostly sedimentary) and on bark of trees. NF to MB--GR to MB, south to GA, TN, MS and LA; in the West from AK to AT, south to CA, ID, AZ and NM.

7. Stems with row of underleaves..8

8. Plants large, stems often over 1 mm wide; underleaves undivided..Porella

PORELLA

A. Underleaves narrow, about the same width as stem, margins plane; plants hygrophytic...........................P. pinnata

Porella pinnata L. **Fig. 26: 7-8**

On rocks and logs in streams or sometimes on bases of trees and stumps subjected to flooding. NS, QU, ON--NS to ON, south to FL, AL, MS, LA and TX.

A. Underleaves broad, wider than the stem, margins reflexed; plants xerophytic...B

B. Ventral leaf lobes narrower than underleaves, tapering at apex..............................P. platyphylla

Porella platyphylla (L.) Pfeiff. **Fig. 26: 4-6**

On shaded, dry rocks or on trees, especially at the base and on exposed roots. NB, NS, QU, ON, MB--NS to MB, south to FL, KY, IL, IA and NE; also in CO, ID, MT, NM, OR and AZ.

B. Ventral leaf lobes about as wide as underleaves, broadly rounded at apex...................P. platyphylloidea

Porella platyphylloidea (Schwein.) Lindb. **Fig. 26: 1-3**
On bark of deciduous trees, also on shaded vertical or steep rocks, boulders and cliff faces. NB, NS, PE, QU, ON--NS to ON, south to FL, MS and LA; also in TX, NM and AZ.

8. Plants small, stems mostly less than 1 mm wide; underleaves bilobed..9

9. Plants reddish brown or dark green; ventral leaf lobes helmet-shaped, attached to stem by slender stalk............................Frullania

FRULLANIA

A. Dorsal leaf lobes with an oblique line of ocelli......................................F. tamarisci ssp. asagrayana

Frullania tamarisci ssp. asagrayana (Mont.) Hatt. **Fig. 27: 1-3**
On rocks, cliffs or tree trunks and limbs. NF to ON--NF to ON, south to FL, AL, AR and OK.

A. Dorsal leaf lobes without line of ocelli.................................B

B. Plants with some erect, nearly naked stem and branch tips due to caducous leaves......................F. bolanderi

Frullania bolanderi Aust. **Fig. 27: 4-6**
On tree trunks or rarely on dry cliffs. NS, PE, QU, ON--LB to ON, south to ME, MI, WI and IA; in the West from BC to CA.

B. Plants without erect, naked stem and branch tips..C

C. Ventral leaf lobes large, more than half the size of the dorsal leaf lobes; dorsal leaf lobes truncate at base.................................F. oakesiana

Frullania oakesiana Aust. **Fig. 28: 1-3**
On tree trunks (often Thuja) mostly in swamps or boggy areas. NF, NS, QU, ON--LB to ON, south in the mountains and northern states to VA, TN, MI, WI and MN.

C. Ventral leaf lobes small, scarcely reaching 1/3 the size of the dorsal leaf lobes; dorsal leaf lobes cordate or auriculate at base....................................D

D. Underleaves without lateral teeth.........................F. eboracensis

Frullania eboracensis Gott. **Fig. 28: 4-7**
On tree trunks (primarily deciduous), occasionally on bare rock. NS to MB--NS to MB, south to FL, AL, KY, AR and TX.

D. Underleaves usually with lateral teeth.....................F. brittoniae

Frullania brittoniae Evans **Fig. 28: 8-10**
On trunks of deciduous trees, rarely on rock. ON--ME to ON, south to FL, TN, MO and TX; also in CO and NM.

9. Plants yellowish green; ventral leaf lobes neither helmet-shaped nor attached to stem by stalk..........*Lejeunea cavifolia*

Lejeunea cavifolia (Ehrh.) Lindb. *emend* Buch **Fig. 25: 5-6**
On shaded rock and bark of trees, rarely on marly soil. NF, NB, NS, QU, ON--NF to ON, south in the mountains and northern states to NC, TN, MI, WI and MN.

10. Underleaves present..........11
10. Underleaves absent..........22

11. Leaves incubous..........12
11. Leaves succubous or transverse..........14

12. Leaves entire or retuse at apex..........*Calypogeia*

CALYPOGEIA

A. Underleaves distinctly bilobed, the sinus descending 1/3-1/4 their length..........*C. muelleriana*

Calypogeia muelleriana (Schiffn.) K. Müll. **Fig. 29: 1-3**
On soil, humus, peaty soil or over rocks in damp, shaded sites. NF to ON--GR to ON, south to GA, TN and KS; in the West from AK to CA.

A. Underleaves entire or retuse at apex..........B

B. Leaves narrowly rounded at apex..........*C. integristipula*

Calypogeia integristipula Steph. **Fig. 29: 4-5**
On mineral soils and organic substrata in coniferous swamps, sometimes on shaded cliffs in woods. NF, NB, QU, ON--GR to ON, south to MA, NY, MI and MN; also in the West from AK to CA and in AT.

B. Leaves truncate to truncate-retuse at apex..........*C. neesiana*

Calypogeia neesiana (Mass. & Carest.) K. Müll. **Fig. 29: 6-7**
On *Sphagnum* or other organic substrata, e.g., badly decayed stumps and logs, humus, and peat; sometimes on loamy soil. NF, NB, NS, QU, ON--GR to ON, south to GA and TN.

12. Leaves with 3-4 teeth or lobes..........13

13. Plants large, stems 3-6 mm wide, ventral flagella present; leaves tridentate..........*Bazzania trilobata*

Bazzania trilobata (L.) S. Gray **Fig. 30: 1-3**
On shaded banks, wet rotten logs and stumps, acidic rocks and bases of trees in moist, shaded woods and swamps. NF to ON--GR to ON, south to FL, AL, MS, AR, IL, IA and MN; in the West from AK and BC.

13. Plants small, stems 1-2 mm wide, ventral flagella lacking; leaves 3-4 lobed into finger-like segments..........*Lepidozia reptans*

Lepidozia reptans (L.) Dum. **Fig. 30: 4-6**
On humus, decaying wood, peaty soil and soil over rock in moist, deeply shaded woods. NF to MB--LB to AK, south to NC, TN, MI, WI, IA, MB, SA, MT, ID and CA; also in NM.

14. Leaves entire or somewhat retuse at apex..........15
14. Leaves 2-4 lobed..........16

15. Underleaves bilobed, often with a tooth on the base of the lobes..........*Chiloscyphus*

CHILOSCYPHUS

A. Plants whitish green; leaves rounded-truncate to truncate, sometimes retuse at apex; sporophytes frequent..........*C. pallescens*

Chiloscyphus pallescens (Ehrh. *ex* Hoffm.) Dum. **Fig. 31: 1-3**
On moist soil, rocks, decaying logs and humus near streams and swamps. NF to ON--LB to AK, south to NC, TN, AR, KS, NM, UT, ID and CA.

A. Plants green to dark green; leaves rounded to rounded-truncate, seldom retuse at apex; sporophytes rare..........*C. polyanthos*

Chiloscyphus polyanthos (L.) Corda **Fig. 31: 4-6**
Usually on soil or humus over noncalcareous rocks beside streams or ponds. NF to ON--NF to ON, south to NC, TN, WI and IA; in the West from AK and BC to AT, south to CA, ID, MT and WY.

15. Underleaves entire, lanceolate..........*Mylia anomala*

Mylia anomala (Hook.) S. Gray **Fig. 32: 1-4**
Over *Sphagnum* in peat bogs and on moist ledges. NF to MB--GR to AK, south to NJ, WV, MI, WI, MN, MB, SA, AT and WA.

16. Leaves 3-4 lobed..........17
16. Leaves 2, rarely 3, lobed..........18

17. Leaves with deeply channelled lobes, the margins broadly reflexed..........*Tetralophozia setiformis*

Tetralophozia setiformis (Ehrh.) Schljak. **Fig. 32: 5-7**
On dry, granitic rock or on ground between boulders. NF, QU, ON--GR to ON, south to ME, NH, VT and NY; in the West from AK to YT, south to BC and AT.

17. Leaves without channelled lobes and reflexed margins..........*Barbilophozia*

BARBILOPHOZIA

A. Leaves mostly 3-lobed, rarely 4-lobed; numerous, erect flagellae arising from stem apices..........*B. attenuata*

Barbilophozia attenuata (Mart.) Loeske **Fig. 33: 1-4**
On boulders, cliff faces and ledges and decaying logs and stumps. NF, NB, NS, QU, ON--GR to ON, south in the mountains and northern states to NC, TN, MI, WI and MN; in the West from AK to BC, south to WA, MT and CO.

A. Leaves mostly 4-lobed, rarely 3-lobed; flagellae lacking..B

B. Leaves acute to obtuse, never mucronate tipped, lacking cilia; underleaves small and indistinct..*B. barbata*

Barbilophozia barbata (Schmid. *ex* Schreb.) Loeske **Fig. 33: 5-7**
Usually on acidic cliff faces and ledges, sometimes on boulders, rarely on rotting logs, mainly in coniferous forests. NF to MB--GR to AK, south to NC, TN, MI, WI, MN, MB, SA, NM, MT, ID and WA.

B. Leaves usually mucronate tipped, the postical leaf base with cilia; underleaves large and distinct..C

C. Plants green or brownish, leaves flat or weakly crisped, middle leaf lobe about as broad as long; reddish brown gemmae often present at shoot apices..*B. hatcheri*

Barbilophozia hatcheri (Evans) Loeske **Fig. 34: 1-4**
Predominantly on acidic cliff faces and ledges, sometimes on boulders, in spruce-fir woods. NF, NB, NS, QU, ON, MB--GR to MB, south to NH, VT, NY, MI and MN; also in NC; in the West from AK to YT, south to CA, MT and CO.

C. Plants whitish or yellowish green, leaves strongly undulate-crispate, middle leaf lobe about twice as broad as long; gemmae lacking................*B. lycopodioides*

Barbilophozia lycopodioides (Wallr.) Loeske **Fig. 34: 5-7**
On acidic cliff faces and ledges, boulders, sometimes on humus over calcareous rock in spruce-fir woods. NF, NB, NS, QU, ON, MB--GR to MB, south to ME, NH and MI; in the West from AK to YT, south to WA, UT and NM.

18. Leaves distant, flat, the lobes obtuse or broadly rounded at apex; plants occurring in *Sphagnum* bogs or in other acidic, subaquatic habitats.................*Cladopodiella fluitans*

Cladopodiella fluitans (Nees) Joerg. **Fig. 35: 1-3**
In and beside standing pools of water in peat bogs. NF to ON--LB to ON, south to NJ, WV, MI and MN; in the West from BC and WA.

18. Leaves mostly close, usually somewhat concave, the lobes acute to narrowly obtuse at apex; plants occurring mostly in drier habitats..19

19. Underleaves entire, attached on one side of base of lateral leaves...*Harpanthus scutatus*

Harpanthus scutatus (Web. & Mohr) Spruce **Fig. 35: 4-6**
Often on siliceous rocks, more rarely on moist decayed logs, humus and peaty soil in damp, shaded sites. NF to ON--LB to ON, south to NC, TN, MI, IA and MN; in the West from BC and AT.

19. Underleaves bilobed or ciliate, rarely entire, not attached to lateral leaves....................20

20. Underleaves bifid nearly to base, the margins without cilia....................Geocalyx graveolens

Geocalyx graveolens (Schrad.) Nees **Fig. 35: 7-9**
On humus or peaty soil, moist, decaying wood, on mineral soil, or on thin soil over rocks. NF to ON--NF to ON, south to NC, TN, IL, MN and KS; in the West from AK to YT, south to CA and ID.

20. Underleaves bifid, divided 1/2-2/3 their length, usually ciliate, or underleaves entire....................21

21. Rhizoids confined to bases of underleaves; underleaves ciliate....................Lophocolea

LOPHOCOLEA

Note - The genus Chiloscyphus has recently been redefined to include Lophocolea. The new names for the two species listed below are Chiloscyphus minor (Nees) Engel & Schust. (for L. minor) and C. profundens (Nees) Engel & Schust. (for L. heterophylla).

A. Plants small, 0.5-1.0 mm wide, usually sterile, clusters of yellowish green gemmae on margins of leaves....................L. minor

Lophocolea minor Nees **Fig. 36: 1-3**
Common on loamy soil banks, in crevices of calcareous shales and sandstones, and on moist rotten logs. NF, NB, NS, QU, ON, MB--NF to MB, south to VA, TN, IL, IA and KS; in the West from AK to YT, south to BC, ID, UT and MT.

A. Plants large, 1-2 mm wide, usually fertile and perianths present, gemmae lacking....................L. heterophylla

Lophocolea heterophylla (Schrad.) Dum. **Fig. 36: 4-6**
Commonly on decaying wood but also on organic substrata, such as tree bases and peat in old dried-out bogs; sometimes on moist soil along streams, and on damp rocks. NF to ON--NF to ON, south to FL, AL, MS, LA and TX; in the West from BC to SA, south to CA, ID and WY.

21. Rhizoids scattered throughout ventral surface of stems; underleaves sometimes entire....................Lophozia

LOPHOZIA

A. Plants with underleaves..B
A. Plants lacking underleaves...C

B. Underleaves ciliate; gemmae lacking.........................L. rutheana

Lophozia rutheana (Limpr.) M.A. Howe **Fig. 37: 1-3**

A calciphile occurring on wet ground in cedar swamps and rich fens. NF, QU, ON, MB--GR to MB, south to NY, MI and MN; in the West from AK, BC, YT and SA.

B. Underleaves entire; gemmae usually present, brownish, on leaf margins at tips of gemmiferous shoots..L. heterocolpos

Lophozia heterocolpos (Thed.) M.A. Howe **Fig. 37: 4-7**

On calcareous rocks or rarely on decaying logs. NF, QU, ON--GR to ON, south to ME, NH, VT, MI, WI and MN; in the West from AK to YT, south to CA, ID and MT.

C. Leaf lobes toothed...L. incisa

Lophozia incisa (Schrad.) Dum. **Fig. 38: 1-4**

An acidophile, on moist, decaying logs, peaty banks, humus-covered rocks, or sometimes on bare, moist rocks. NF to MB--GR to MB, south in the mountains and northern states to NC, TN, MI, WI and MN; in the West from AK to YT, south to CA, NV and NM.

C. Leaf lobes entire...D

D. Leaves about as wide long, the sinus broad and shallow; gemmae greenish or yellowish green............L. ventricosa

Lophozia ventricosa (Dicks.) Dum. **Fig. 38: 5-8**

On moist, shaded rocks, decaying logs and peaty soil. NF to MB--GR to AK, south to NC, TN, MI, WI, MN, MB, CO, MT, ID and CA.

D. Leaves much longer than wide, the sinus narrow and deep; gemmae orange or reddish brown...L. longidens

Lophozia longidens (Lindb.) Mac. **Fig. 38: 9-12**

On acidic rocks, decaying wood and bases of trees. NF, NS, QU, ON--GR to ON, south to CT, NY, MI, WI and MN; in the West from BC to AT, south to OR, ID, MT and CO.

22. Leaves undivided or nearly so...23
22. Leaves 2-4 lobed...26

23. Rhizoids purple or violet; leaves wavy or ruffled when dry..................Fossombronia foveolata

Fossombronia foveolata Lindb. **Fig. 39: 1-4**

On damp, sandy soil at lake margins and beside streams. NS, QU, ON--NS to ON, south to NC, TN, MI and WI; in the West from BC to OR.

23. Rhizoids not purple or violet, usually hyaline or brownish; leaves not wavy or ruffled when dry..24

24. Leaves usually with serrated margins........................*Plagiochila porelloides*

Plagiochila porelloides (Torrey *ex* Nees) Lindenb. **Fig. 39: 5-6**
(Spleenwort Hepatic)
On moist rocks and shaded, soil-covered banks, rarely on rotten logs, stumps and bases of trees. NF to MB--GR to MB, south to GA, KY and AR; in the West from AK to SA, south to CA, ID, MT and NM.

24. Leaves with entire margins (female bracts sometimes ciliate)...25

25. Plants green to reddish brown; female bracts ciliate at base; perianth tapered to a ciliate mouth; common, on rotten wood, soil or rocks, never in streams..................*Jamesoniella autumnalis*

Jamesoniella autumnalis (DC.) Steph. **Fig. 40: 1-3**
Usually on decaying logs or acidic rocks, sometimes on shaded banks and occasionally on bases of trees. NF to MB--NF to AK, south to FL, TN, MS, MO, KS, WY, MT, ID and OR.

25. Plants green or some plants reddish with a border of enlarged cells; female bracts entire; perianths truncate or tapered, the mouth entire; infrequent, on rotten wood, soil or rocks, sometimes in streams......................................*Jungermannia*

JUNGERMANNIA

A. Leaves with a distinct border of large, swollen cells..*J. gracillima*

Jungermannia gracillima Sm. **Fig. 40: 9-10**
On sandy, loamy or clayey banks. NF to ON--GR to ON, south to FL, AL, MS, WI and IA.

A. Leaves lacking border of enlarged cells..................................B

B. Leaves oblong-oval, often slightly retuse at apex; perianth truncate at apex; plants mostly in mesic habitats.........................*J. leiantha*

Jungermannia leiantha Grolle **Fig. 40: 4-6**
On moist rock, on soil over rock, on decaying logs and on peaty ground in boggy areas. NF, NS, PE, QU, ON--LB to ON, south to GA, AL, MI, WI, MN and KS; in the West from AK and BC, south to CA, ID, MT and UT.

B. Leaves cordate to nearly rounded, not retuse at apex; perianth tapered at apex; plants in aquatic habitats..........................*J. exsertifolia* ssp. *cordifolia*

Jungermannia exsertifolia ssp. cordifolia (Dum.) Vana
Fig. 40: 7-8
On rocks in or beside silt-free streams. NF, NS, QU, ON--NF to ON, south to CT, NY, MI and WI; in the West from AK to AT, south to CA, ID and CO.

26. Leaves 3-4 lobed...27
26. Leaves 2 lobed...29

27. Leaf lobes all about the same size............................*Barbilophozia* (See p. 43)
27. Leaf lobes unequal in size, the dorsal lobe much shorter than the ventral lobe..28

28. Leaf lobes entire; gemmae reddish brown, sometimes lacking...*Tritomaria*

TRITOMARIA

A. Leaves as wide or wider than long; gemmae lacking..*T. quinquedentata*

Tritomaria quinquedentata (Hedw.) Buch **Fig. 41: 1-3**
On basic rock outcrops and around rock pools. NF, NB, NS, QU, ON, MB--GR to MB, south to CT, NY, MI, WI and MN; in the West from AK to YT, south to BC and AT.

A. Leaves longer than wide; gemmae usually present, reddish brown....................................*T. exsectiformis*

Tritomaria exsectiformis (Breidl.) Loeske **Fig. 41: 4-6**
On decaying logs and peaty soil over acidic cliffs. NF, NB, NS, QU, ON--NF to ON, south to MA, NY, MI, WI and IA; also in NC; in the West from AK to YT, south to BC, AT, ID, MT and CO.

28. Leaf lobes toothed; gemmae green or yellowish green, usually present..*Lophozia* (See p. 46)

29. Leaves strongly concave and sac-like, each lobe ending in a long, slender cilium; occurring only on rotten wood...*Nowellia curvifolia*

Nowellia curvifolia (Dicks.) Mitt. **Fig. 42: 1-3**
On moist decaying logs. NF to ON--NF to ON, south to GA, TN and AR.

29. Leaves neither sac-like nor ending in long cilia; on wood and other substrates...30

30. Leaves transverse..31
30. Leaves succubous...32

31. Leaves deeply divided, 1/3-1/2 their length; gemmae usually present, reddish or purplish brown..............................*Anastrophyllum*

ANASTROPHYLLUM

A. Plants small, gemmiferous shoots filiform, 0.5-1.5 mm wide...*A. minutum*

Anastrophyllum minutum (Schreb.) Schust. **Fig. 42: 4-6**
On peaty soil, often among mosses and on damp, shaded rocks. NF, NB, NS, QU, ON--GR to ON, south in the mountains and northern states to NC, TN, MI and MN; in the West from AK to YT, south to WA and ID.

A. Plants larger, gemmiferous shoots not filiform, 1.0-2.5 mm wide.......................................*A. michauxii*

Anastrophyllum michauxii (Web.) Buch ex Evans **Fig. 42: 7-9**
On acidic cliff faces and ledges, sometimes on decaying logs. NF, NB, NS, QU, ON, MB--LB to MB, south in the mountains and northern states to NC, TN, MI, WI and MN; in the West from AK to YT, south to WA, ID, AT and WY.

31. Leaves shallowly divided, 1/8-1/3 their length; gemmae lacking..Marsupella

MARSUPELLA

A. Leaves weakly bilobed, the sinus shallow and broad, extending about 1/5 the leaf length, dorsal margin distinctly reflexed..................................M. emarginata

Marsupella emarginata (Ehrh.) Dum. **Fig. 43: 1-3**
On moist, acid rocks beside streams. NF to ON--GR to ON, south to GA, TN, MI, and MN; in the West from AK to YT, south to CA, AT, MT and CO.

A. Leaves strongly bilobed, the sinus deep and narrow, extending about 1/3 the leaf length, dorsal margin plane......................................M. sphacelata

Marsupella sphacelata (Gieseke) Dum. **Fig. 43: 4-6**
On acidic rocks and cliffs in and along streams, sometimes on dry, sunny cliffs. NF, NS, QU, ON--GR to ON, south to GA and TN; in the West from AK to AT, south to CA and ID.

32. Leaf lobes obtuse to broadly rounded.. 33
32. Leaf lobes acute to acuminate..34

33. Leaves somewhat concave, about as broad as long, the lobes about equal in size.......................................Gymnocolea inflata

Gymnocolea inflata (Huds.) Buch **Fig. 44: 1-3**
On humus over wet to moist, acidic rocks and rock outcrops, or sometimes in depressions in bogs. NF to MB--GR to AK, south to NJ, PA, MI, MN, SD, WY, AT and CA; also in NC, TN and AR.

33. Leaves flat, much longer than broad, the ventral lobe larger than the dorsal lobe......................Cladopodiella fluitans (See p. 44)

34. Plants small, usually 0.5-1.0 mm wide, stems transparent; leaves deeply cleft, the lobes often connivent...Cephalozia

CEPHALOZIA

A. Leaves deeply divided, the sinus extending 1/2 or more the leaf length, the lobes nonconnivent..C. bicuspidata

Cephalozia bicuspidata (L.) Dum. **Fig. 44: 4-5**
On moist, acid rocks, mineral soil and peaty or sandy banks beside streams, sometimes on decaying logs. NF to ON--GR to AK, south to GA, TN, IL, IA, KS, CO, UT, ID and CA.

A. Leaves more shallowly divided, the sinus extending less than 1/2 the leaf length, the lobes usually connivent.................................C. lunulifolia

Cephalozia lunulifolia (Dum.) Dum. **Fig. 44. 6-7**
Most often on decaying wood and in peat bogs, but also on moist rock, in soil-filled rock crevices and on soil banks. NF to MB--GR to AK, south to FL, TN, LA, KS, WY, ID, NV and CA.

34. Plants large, mostly over 1 mm wide, stems opaque; leaves shallowly cleft, without connivent lobes...Lophozia (See p. 46)

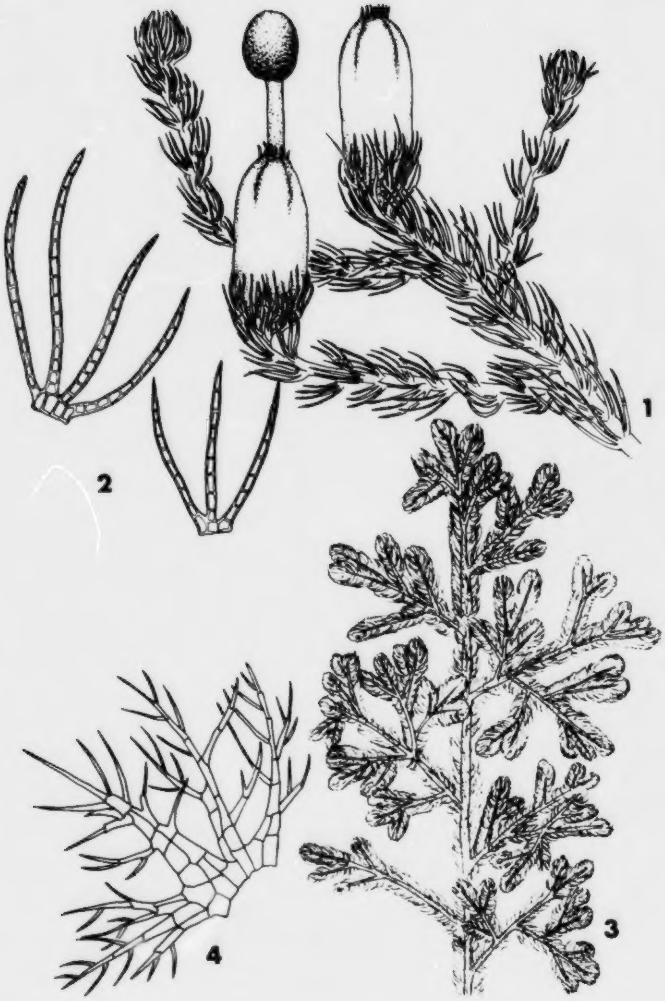

FIGURE 18. 1-2, **Blepharostoma trichophyllum**. 1. Habit of plant with perianths and sporophyte (x23). 2. Leaves (x36). 3-4. **Trichocolea tomentella**. 3. Habit (x2). 4. Leaf (x36).

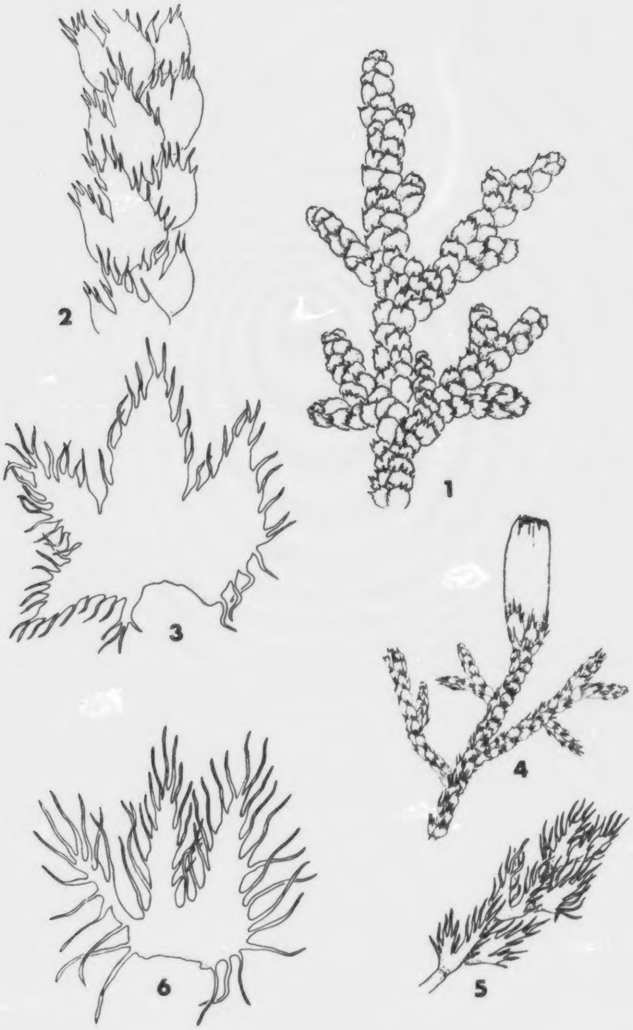

FIGURE 19. 1-3, **Ptilidium ciliare.** 1. Habit (x3). 2. Portion of stem (x12). 3. Leaf (x30). 4-6, **Ptilidium pulcherrimum.** 4. Habit of plant with perianth (x3). 5. Portion of stem (x12). 6. Leaf (x30).

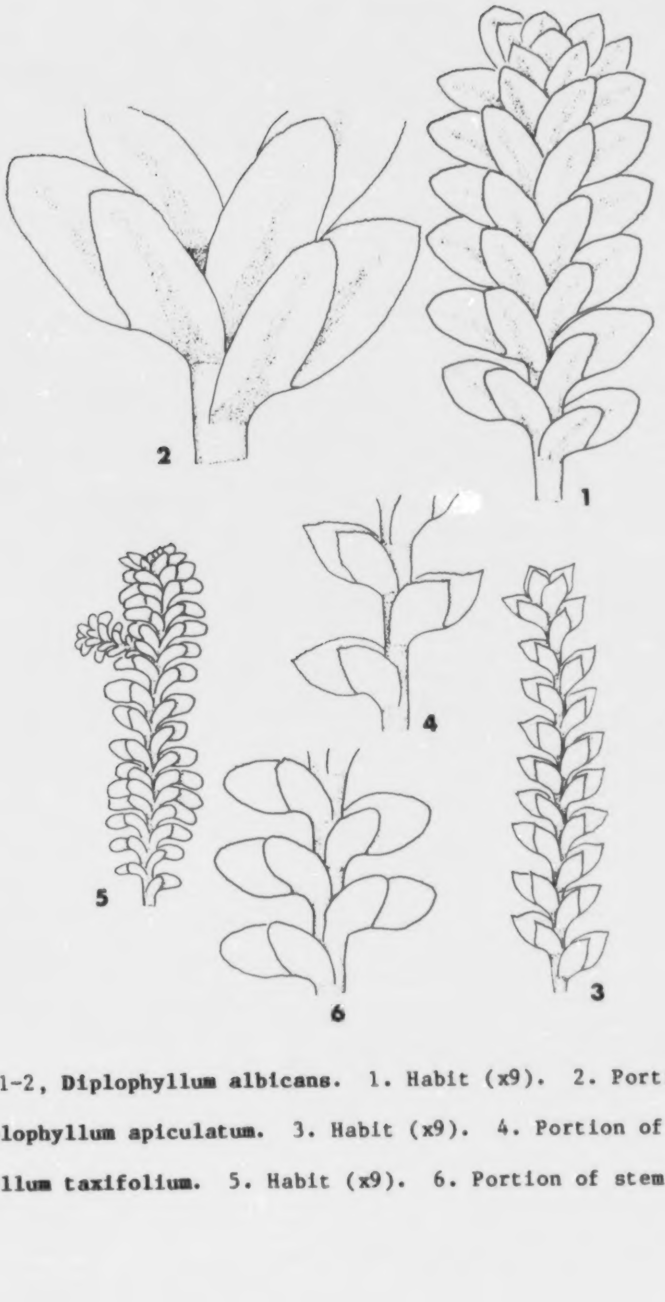

FIGURE 20. 1-2, **Diplophyllum albicans**. 1. Habit (x9). 2. Portion of stem (x18). 3-4, **Diplophyllum apiculatum**. 3. Habit (x9). 4. Portion of stem (x18). 5-6, **Diplophyllum taxifolium**. 5. Habit (x9). 6. Portion of stem (x18).

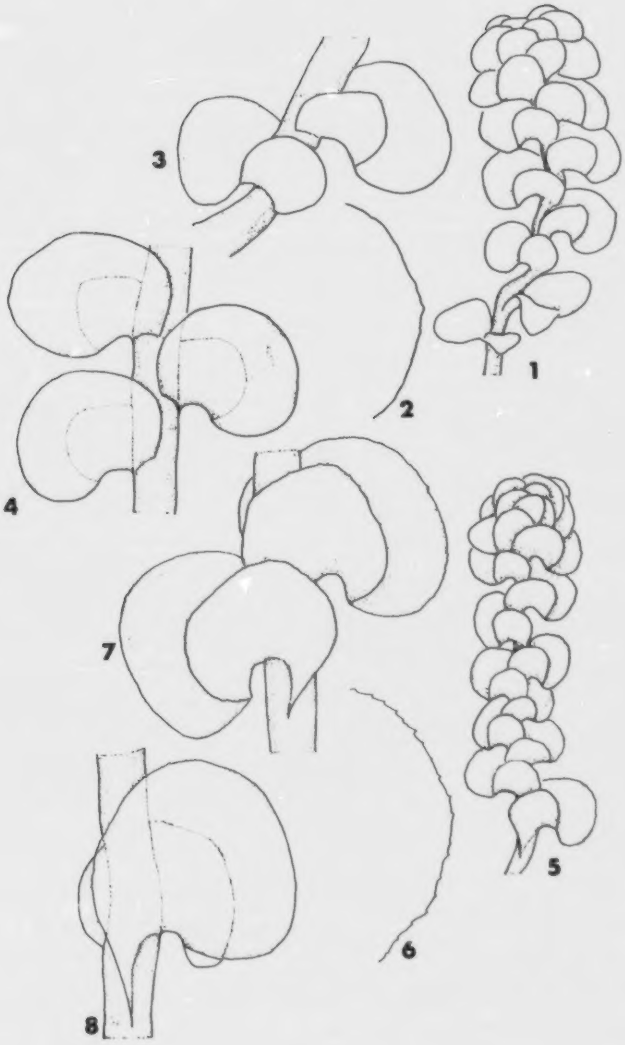

FIGURE 21. 1-4, **Scapania irrigua.** 1. Habit (x9). 2. Portion of ventral leaf margin (x36). 3. Dorsal view of leaves (x18). 4. Ventral view of leaves (x18). 5-8, **Scapania paludosa.** 5. Habit (x9). 6. Portion of ventral leaf margin (x36). 7. Dorsal view of leaves (x18). 8. Ventral view of leaves (x18).

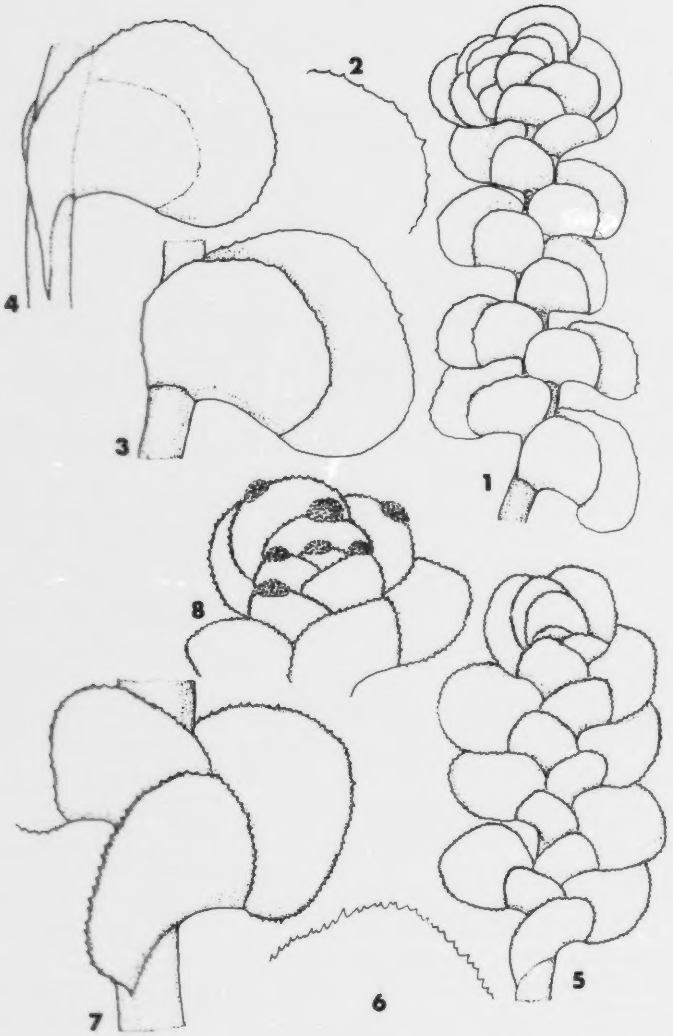

FIGURE 22. 1-4, **Scapania undulata.** 1. Habit (x9). 2. Portion of ventral leaf margin (x36). 3. Dorsal view of leaves (x18). 4. Ventral view of leaves (x18). 5-8, **Scapania nemorosa.** 5. Habit (x9). 6. Portion of ventral leaf margin (x36). 7. Dorsal view of leaves (x18). 8. Gemmae on leaves (x18).

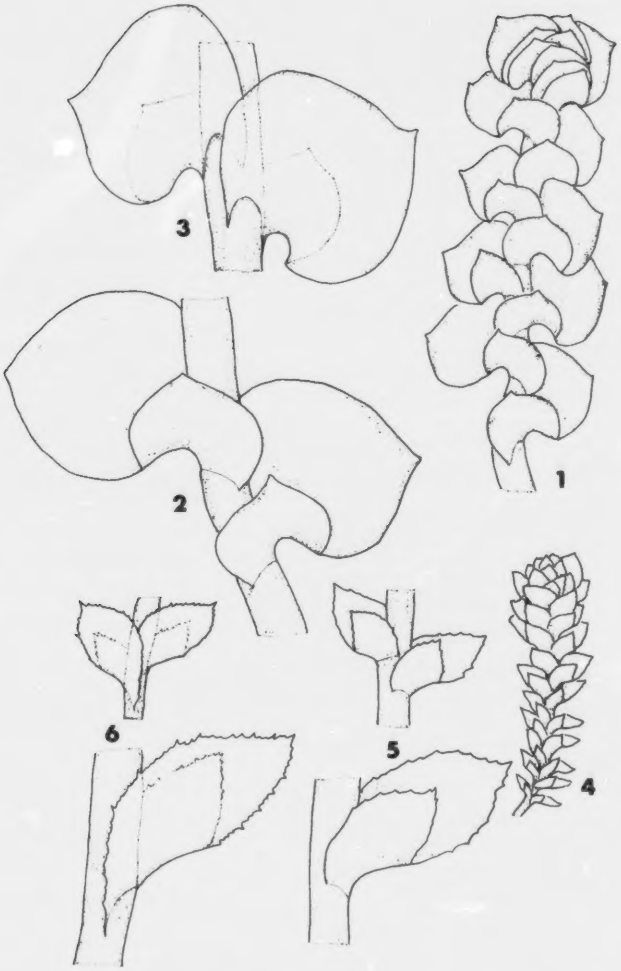

FIGURE 23. 1-3, **Scapania paludicola.** 1. Habit (x9). 2. Dorsal view of leaves (x18). 3. Ventral view of leaves (x18). 4-6, **Scapania umbrosa.** 4. Habit (x9). 5. Dorsal view of leaves (x18, x36). 6. Ventral view of leaves (x18, x36).

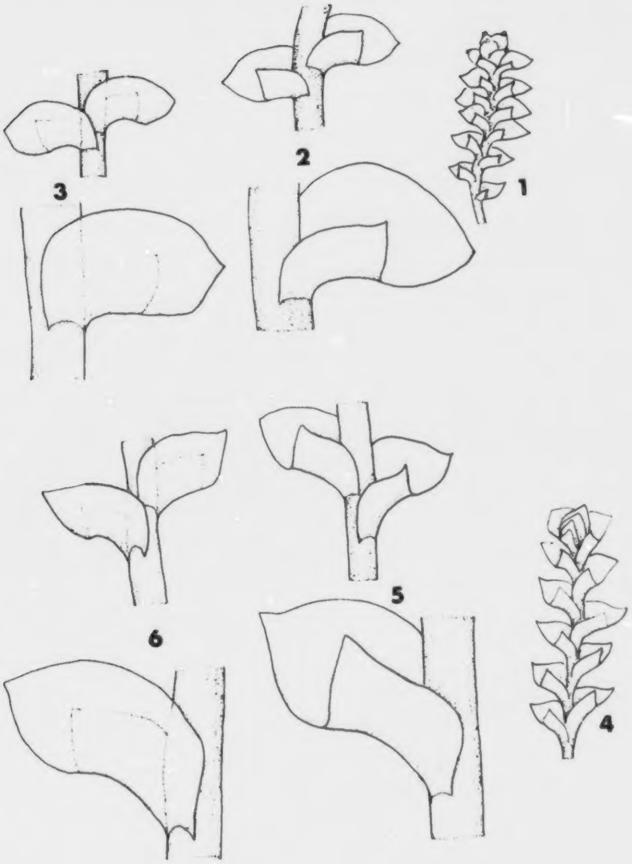

FIGURE 24. 1-3, **Scapania gymnostomophila.** 1. Habit (x9). 2. Dorsal view of leaves (x18, x36). 3. Ventral view of leaves (x18, x36). 4-6, **Scapania mucronata.** 4. Habit (x9). 5. Dorsal view of leaves (x18, x36). 6. Ventral view of leaves (x18, x36).

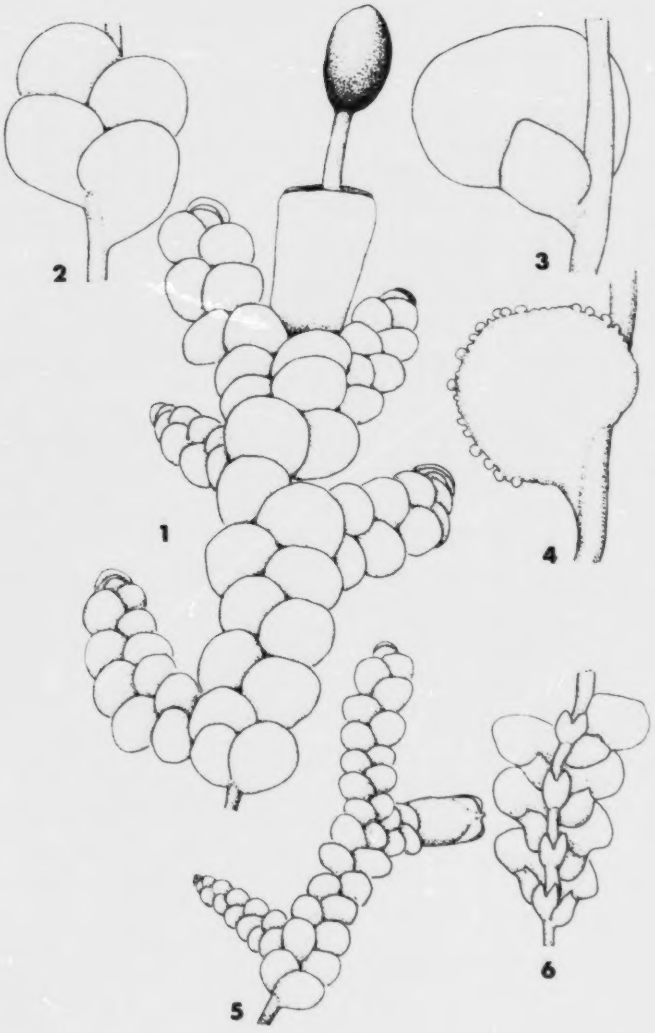

FIGURE 25. 1-4, **Radula complanata.** 1. Habit of plant with perianth and sporophyte (x18). 2. Dorsal view of leaves (x23). 3. Ventral view of leaf (x36). 4. Dorsal view of leaf with gemmae (x36). 5-6, **Lejeunea cavifolia.** 5. Habit of plant with perianth (x18). 6. Ventral view of leaves (x36).

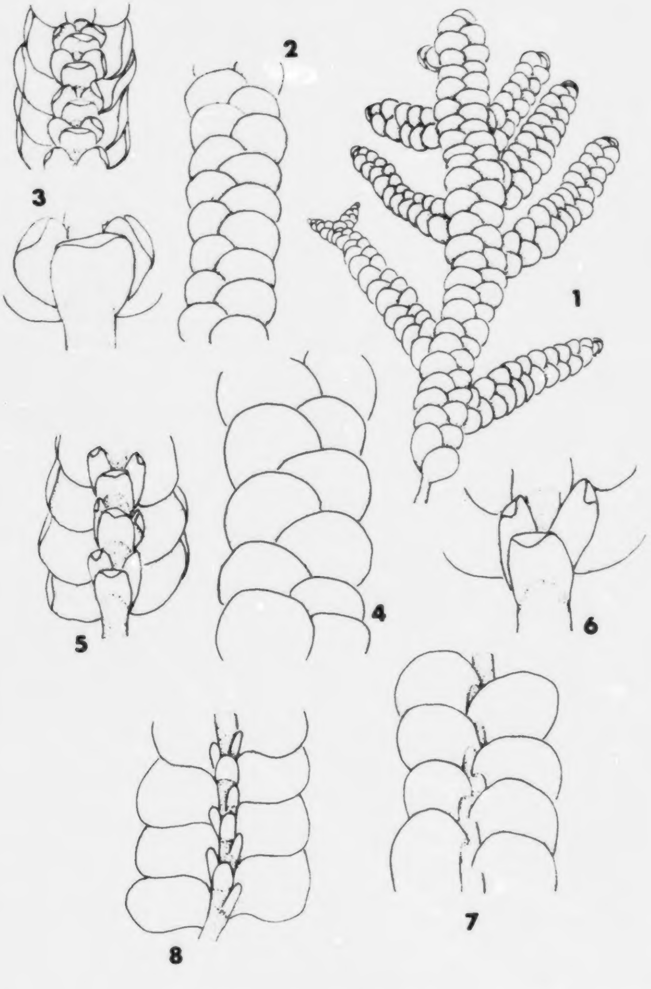

FIGURE 26. 1-3, **Porella platyphylloidea.** 1. Habit (x4). 2. Dorsal view of leaves (x9). 3. Ventral view of leaves (x9, x18). 4-6, **Porella platyphylla.** 4. Dorsal view of leaves (x9). 5. Ventral view of leaves (x9). 6. Ventral view of leaves (x18). 7-8, **Porella pinnata.** 7. Dorsal view of leaves (x9). 8. Ventral view of leaves (x9).

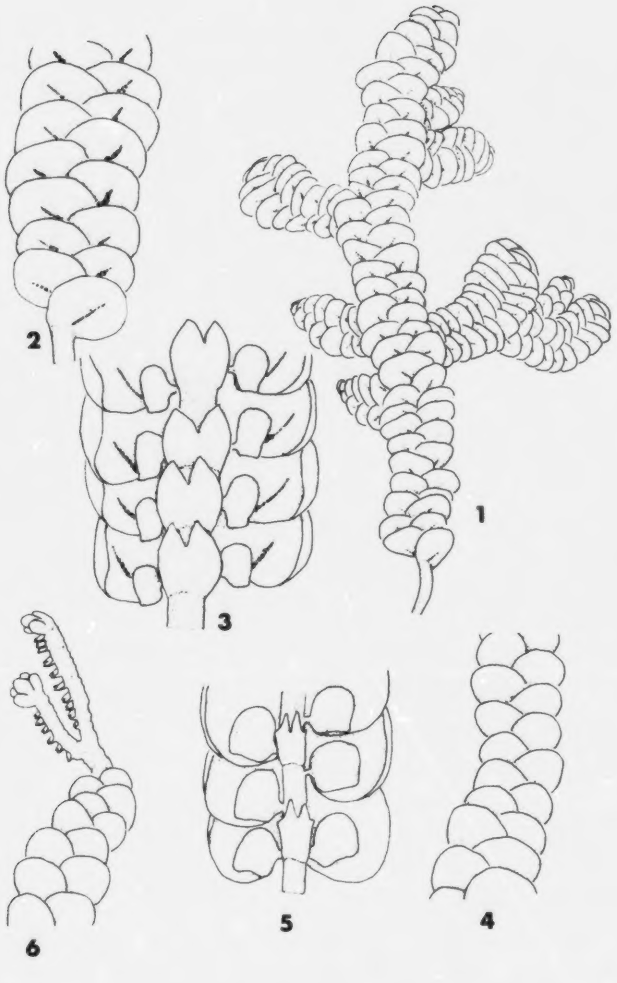

FIGURE 27. 1-3, **Frullania tamarisci** ssp. **asagrayana**. 1. Habit (x9). 2. Dorsal view of leaves (x18). 3. Ventral view of leaves (x36). 4-6, **Frullania bolanderi**. 4. Dorsal view of leaves (x18). 5. Ventral view of leaves (x36). 6. Dorsal view of caducous-leaved stem (x18).

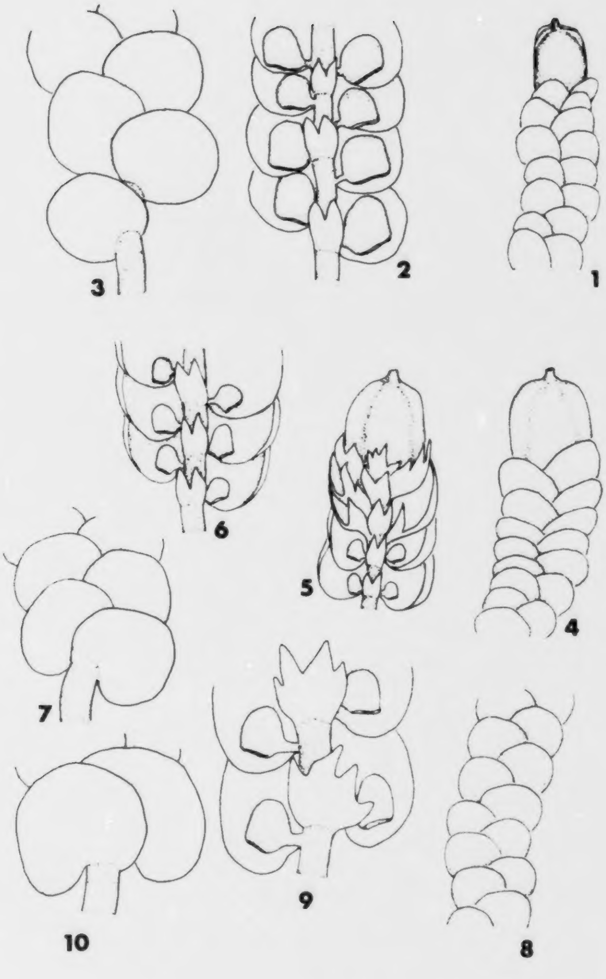

FIGURE 28. 1-3, **Frullania oakesiana.** 1. Dorsal view of stem apex with perianth (x18). 2. Ventral view of leaves (x36). 3. Dorsal view of leaves (x36). 4-7, **Frullania eboracensis.** 4. Dorsal view of stem apex with perianth (x18). 5. Ventral view of stem apex with perianth (x18). 6. Ventral view of leaves (x36). 7. Dorsal view of leaves (x36). 8-10, **Frullania brittoniae.** 8. Dorsal view of leaves (x18). 9. Ventral view of leaves (x36). 10. Dorsal view of leaves (x36).

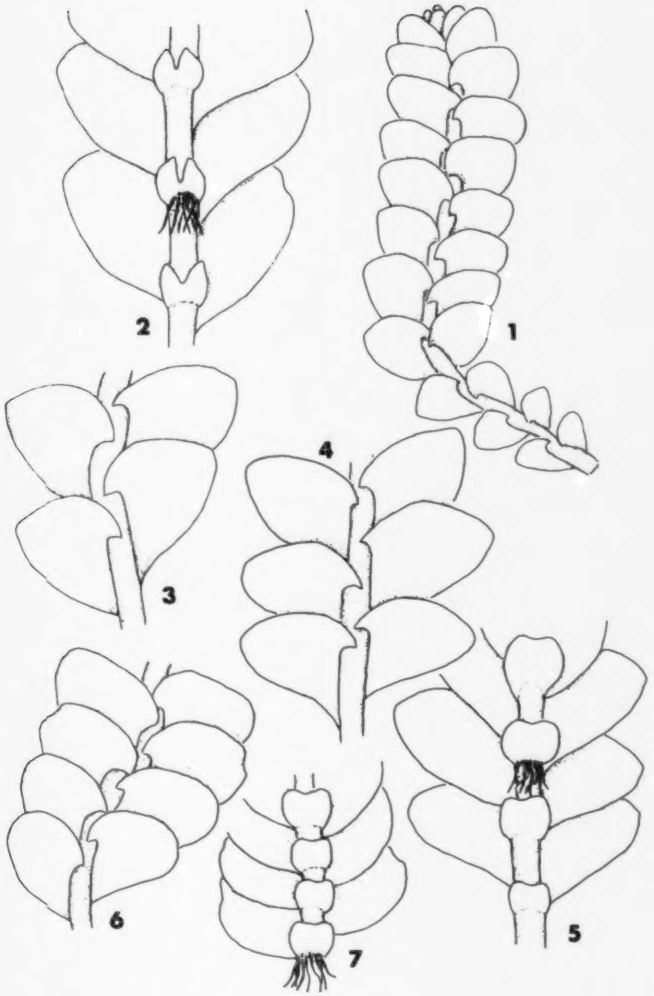

FIGURE 29. 1-3, **Calypogeia muelleriana**. 1. Habit (x9). 2. Dorsal view of leaves (x18). 3. Ventral view of leaves (x18). 4-5, **Calypogeia integristipula**. 4. Dorsal view of leaves (x18). 5. Ventral view of leaves (x18). 6-7, **Calypogeia neesiana**. 6. Dorsal view of leaves (x18). 7. Ventral view of leaves (x18).

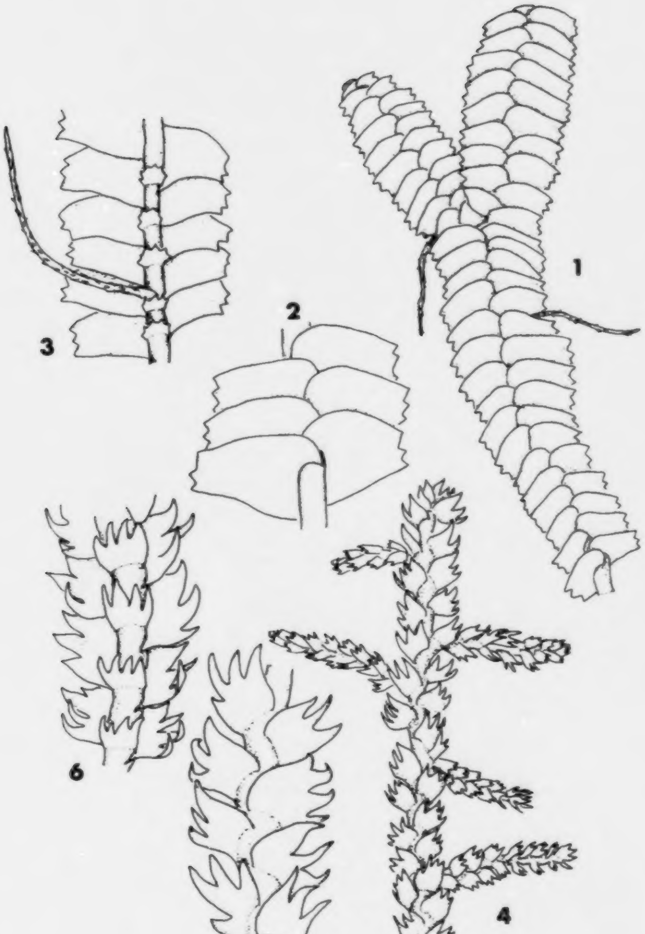

FIGURE 30. 1-3, **Bazzania trilobata.** 1. Habit (x4). 2. Dorsal view of leaves (x9). 3. Ventral view of leaves (x9). 4-6, **Lepidozia reptans.** 4. Habit (x18). 5. Dorsal view of leaves (x36). 6. Ventral view of leaves (x36).

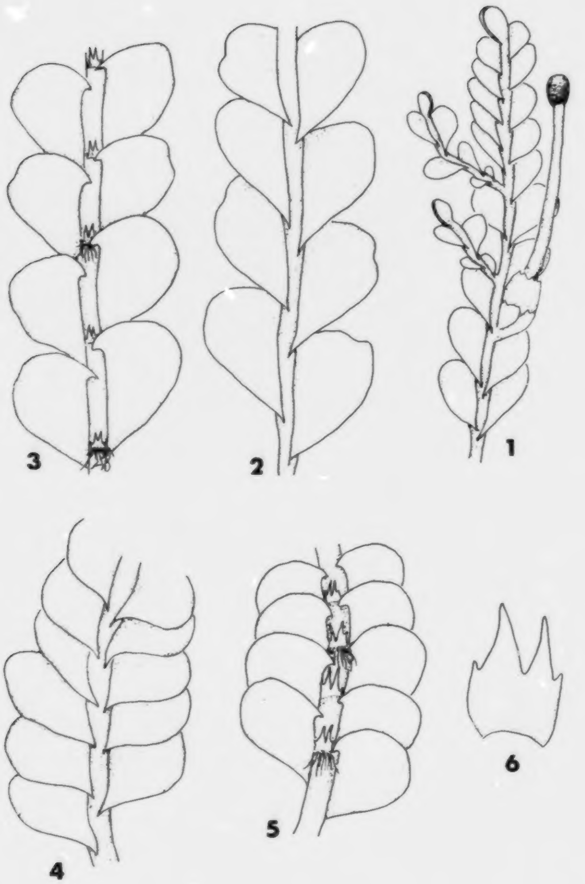

FIGURE 31. 1-3, **Chiloscyphus pallescens.** 1. Habit (x4). 2. Dorsal view of leaves (x9). 3. Ventral view of leaves (x9). 4-6, **Chiloscyphus polyanthos.** 4. Dorsal view of leaves (x9). 5. Ventral view of leaves (x9). 6. Underleaf (x36).

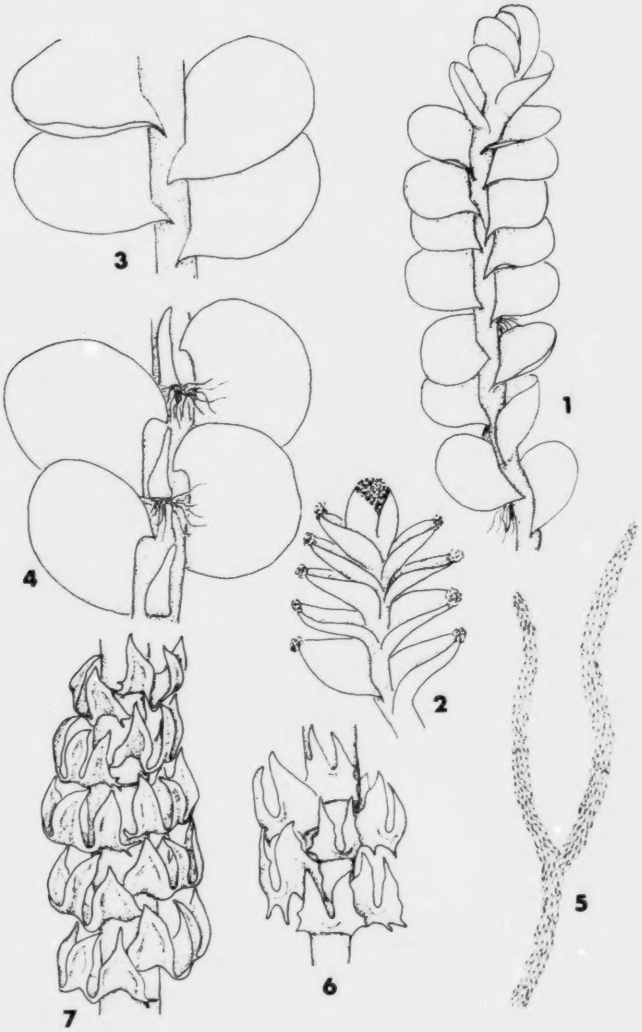

FIGURE 32. 1-4, **Mylia anomala.** 1. Habit (x9). 2. Gemmiferous stem apex (x9). 3. Dorsal view of leaves (x18). 4. Ventral view of leaves (x18). 5-7, **Tetralophozia setiformis.** 5. Habit (x4). 6. Ventral view of leaves (x36). 7. Dorsal view of leaves (x36).

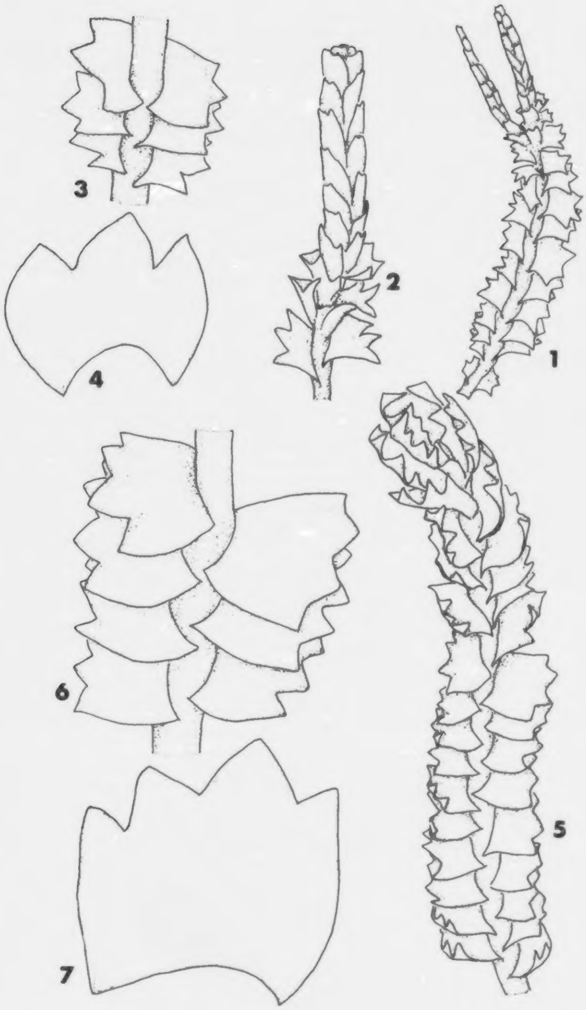

FIGURE 33. 1-4, **Barbilophozia attenuata.** 1. Habit with flagellae (x9). 2. Flagellum at stem apex (x18). 3. Dorsal view of leaves (x18). 4. Leaf (x36). 5-7, **Barbilophozia barbata.** 5. Habit (x9). 6. Dorsal view of leaves (x18). 7. Leaf (x36).

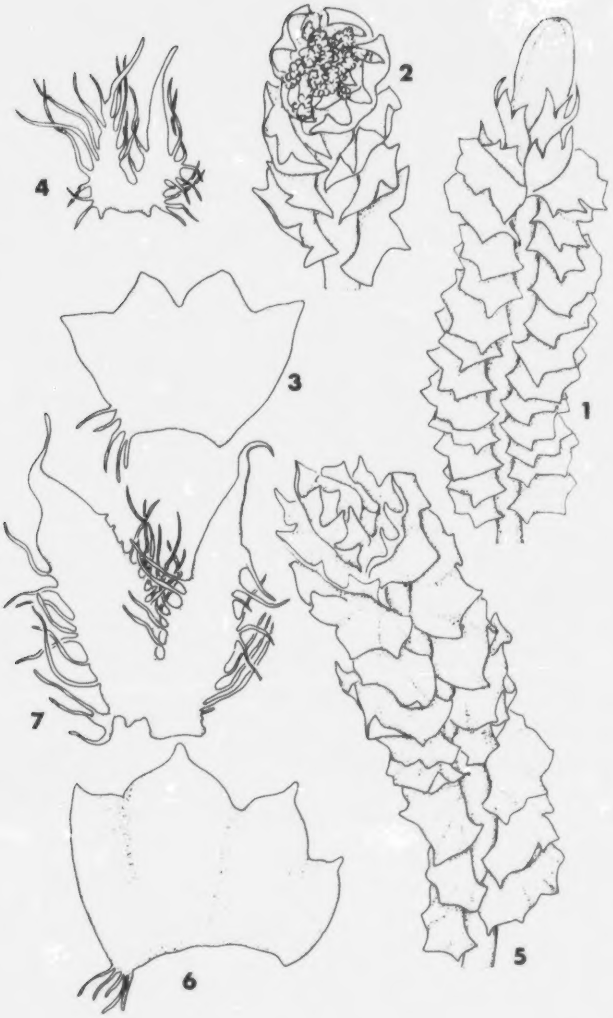

FIGURE 34. 1-4, **Barbilophozia hatcheri.** 1. Habit of plant with perianth (x9). 2. Gemmiferous stem apex (x9). 3. Leaf (x18). 4. Underleaf (x36). 5-7, **Barbilophozia lycopodioides.** 5. Habit (x9). 6. Leaf (x18). 7. Underleaf (x36).

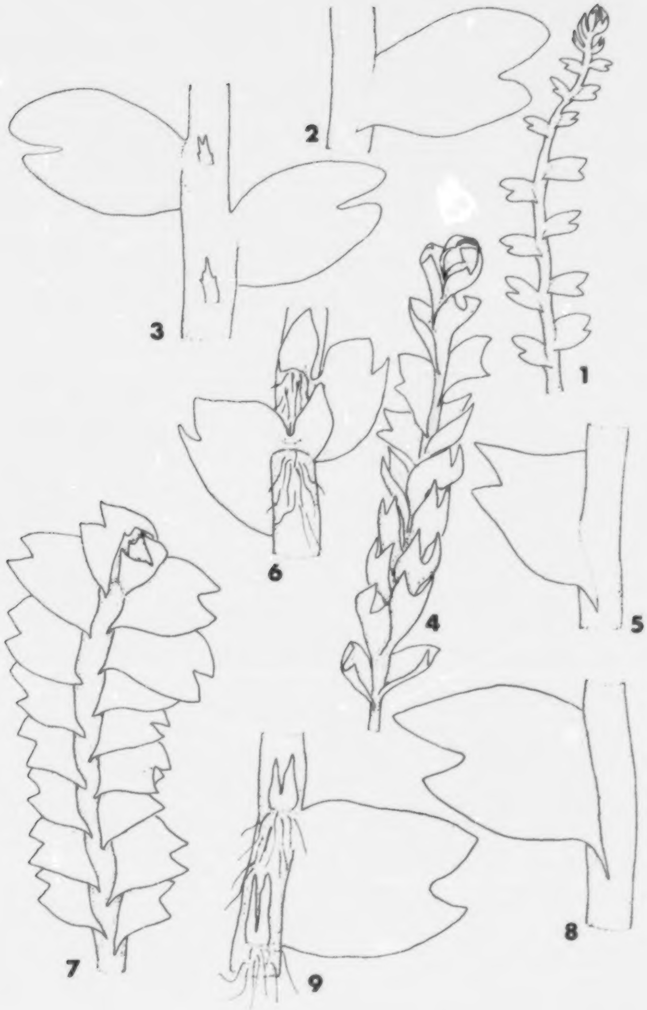

FIGURE 35. 1-3, **Cladopodiella fluitans.** 1. Habit (x9). 2. Dorsal view of leaf (x36). 3. Ventral view of leaves (x36). 4-6, **Harpanthus scutatus.** 4. Habit (x18). 5. Dorsal view of leaf (x36). 6. Ventral view of leaves (x36). 7-9, **Geocalyx graveolens.** 7. Habit (x18). 8. Dorsal view of leaf (x36). 9. Ventral view of leaves (x36).

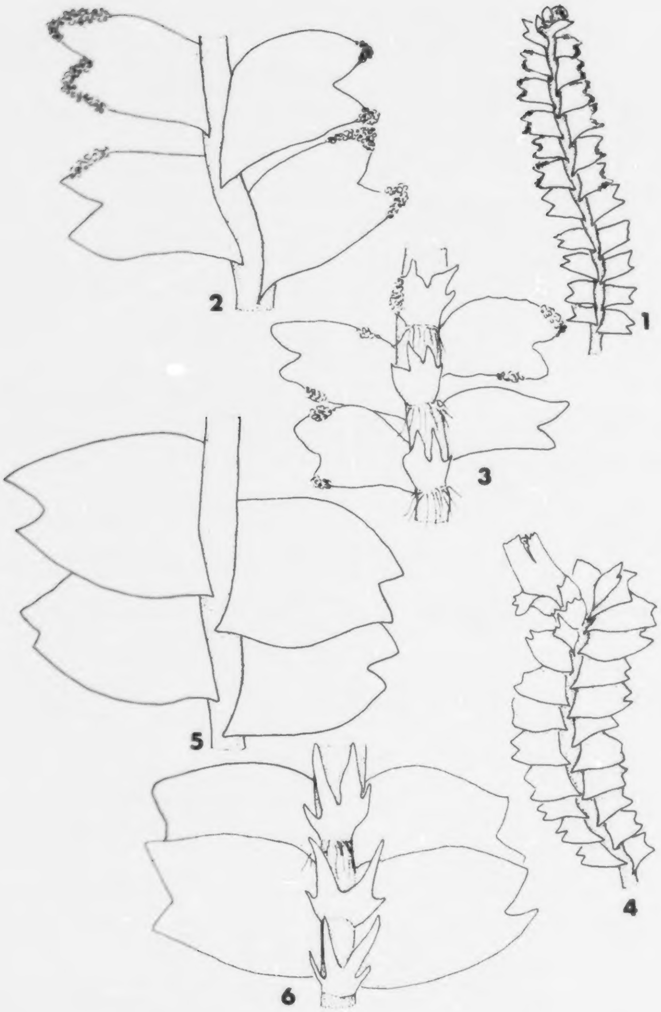

FIGURE 36. 1-3, **Lophocolea minor.** 1. Habit (x9). 2. Dorsal view of leaves with gemmae (x36). 3. Ventral view of leaves with gemmae (x36). 4-6, **Lophocolea heterophylla.** 4. Habit of plant with perianth (x9). 5. Dorsal view of leaves (x36). 6. Ventral view of leaves (x36).

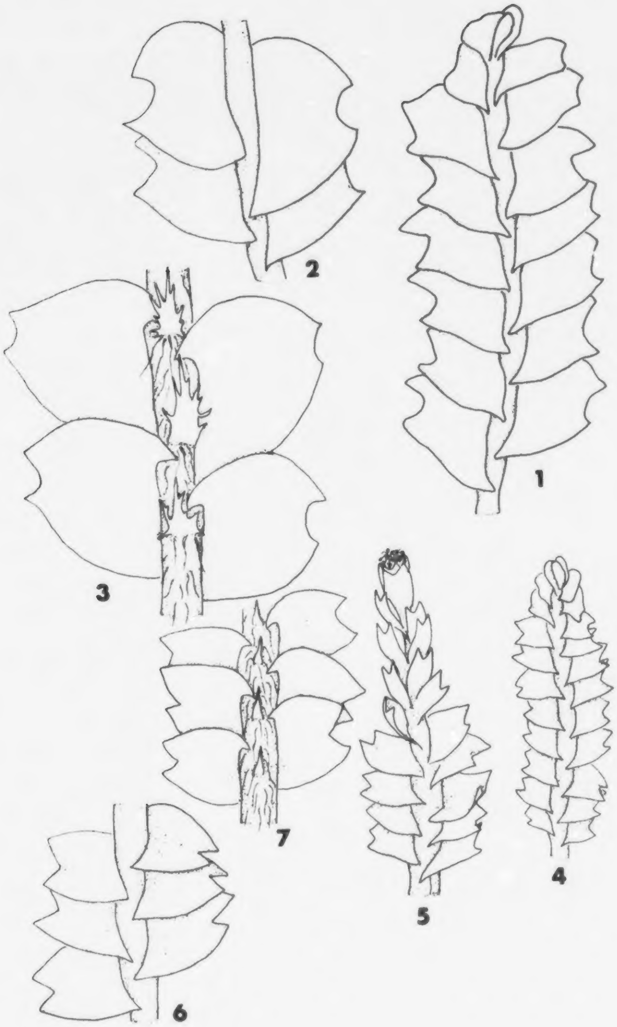

FIGURE 37. 1-3, **Lophozia rutheana.** 1. Habit (x9). 2. Dorsal view of leaves (x18). 3. Ventral view of leaves (x18). 4-7, **Lophozia heterocolpos.** 4. Habit (x9). 5. Gemmiferous stem apex (x18). 6. Dorsal view of leaves (x18). 7. Ventral view of of leaves (x18).

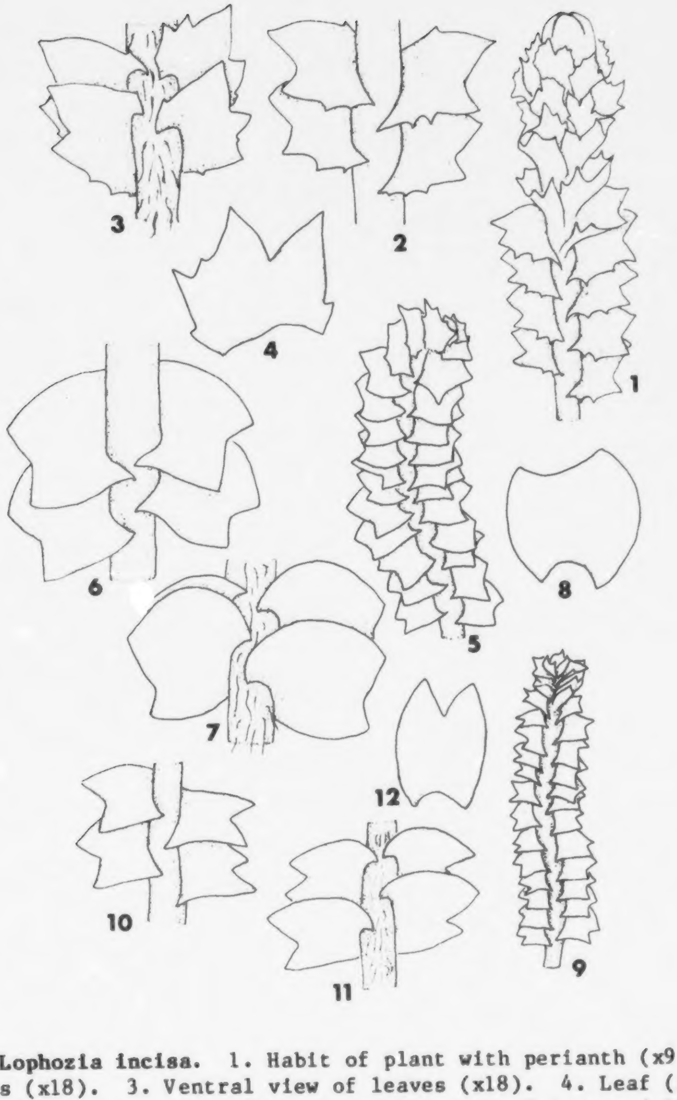

FIGURE 38. 1-4, **Lophozia incisa.** 1. Habit of plant with perianth (x9). 2. Dorsal view of leaves (x18). 3. Ventral view of leaves (x18). 4. Leaf (x18). 5-8, **Lophozia ventricosa.** 5. Habit (x9). 6. Dorsal view of leaves (x18). 7. Ventral view of leaves (x18). 8. Leaf (x18). 9-12, **Lophozia longidens.** 9. Habit (x9). 10. Dorsal view of leaves (x18). 11. Ventral view of leaves (x18). 12. Leaf (x18).

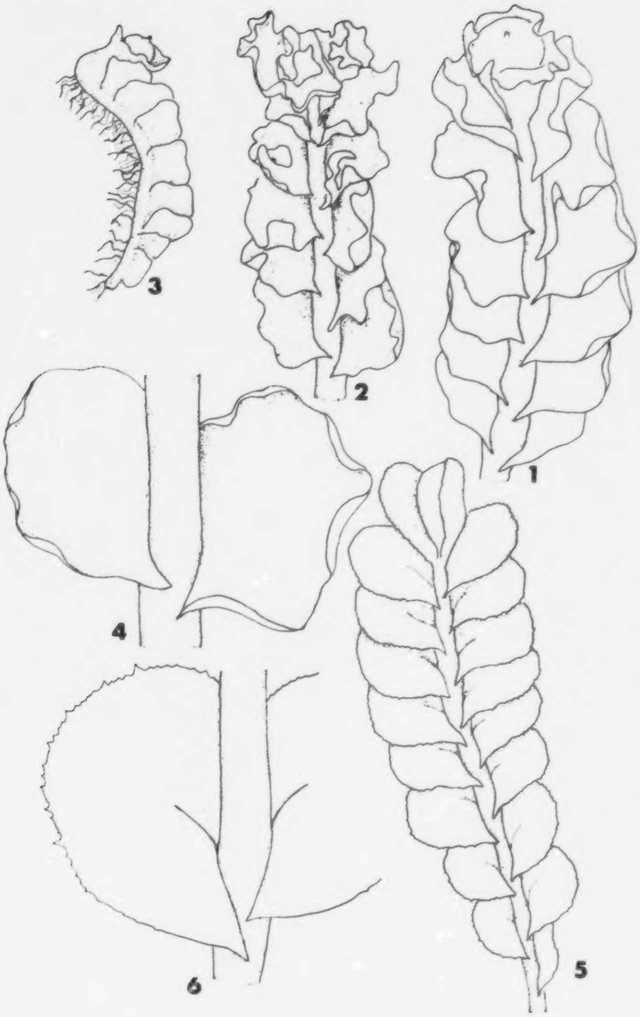

FIGURE 39. 1-4, **Fossombronia foveolata**. 1. Habit, wet (x18). 2. Habit, dry (x18). 3. Habit, side view (x9). 4. Dorsal view of leaves (x36). 5-6, **Plagiochila porelloides**. 5. Habit (x9). 6. Dorsal view of leaf (x18).

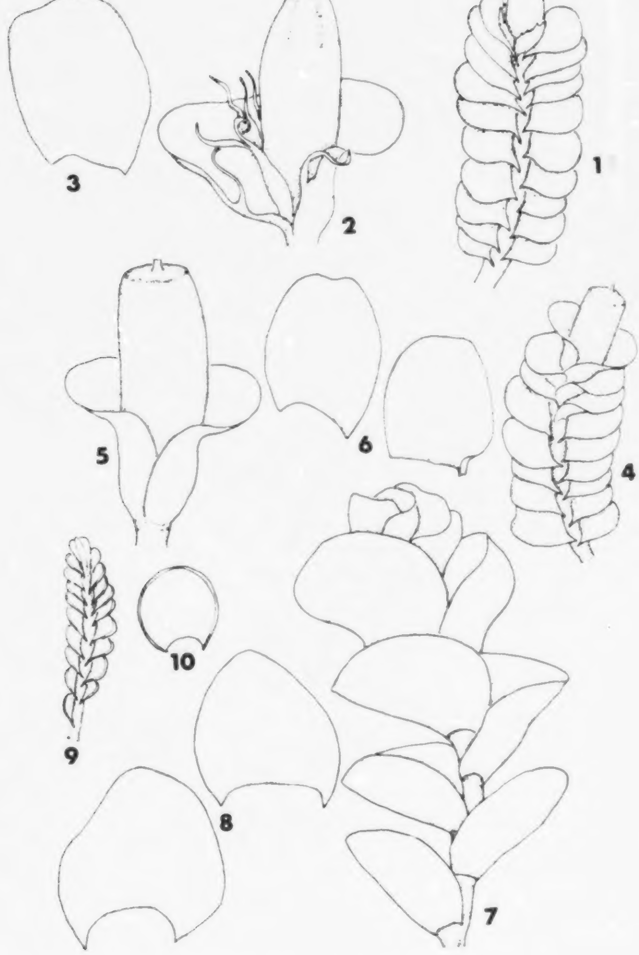

FIGURE 40. 1-3, **Jamesoniella autumnalis.** 1. Habit of plant with perianth (x9). 2. Perianth and female bracts (x18). 3. Leaf (x18). 4-6, **Jungermannia leiantha.** 4. Habit of plant with perianth (x9). 5. Perianth and female bracts (x18). 6. Leaves (x18). 7-8, **Jungermannia exsertifolia** ssp. **cordifolia.** 7. Habit (x9). 8. Leaves (x9). 9-10, **Jungermannia gracillima.** 9. Habit (x9). 10. Leaf (x18).

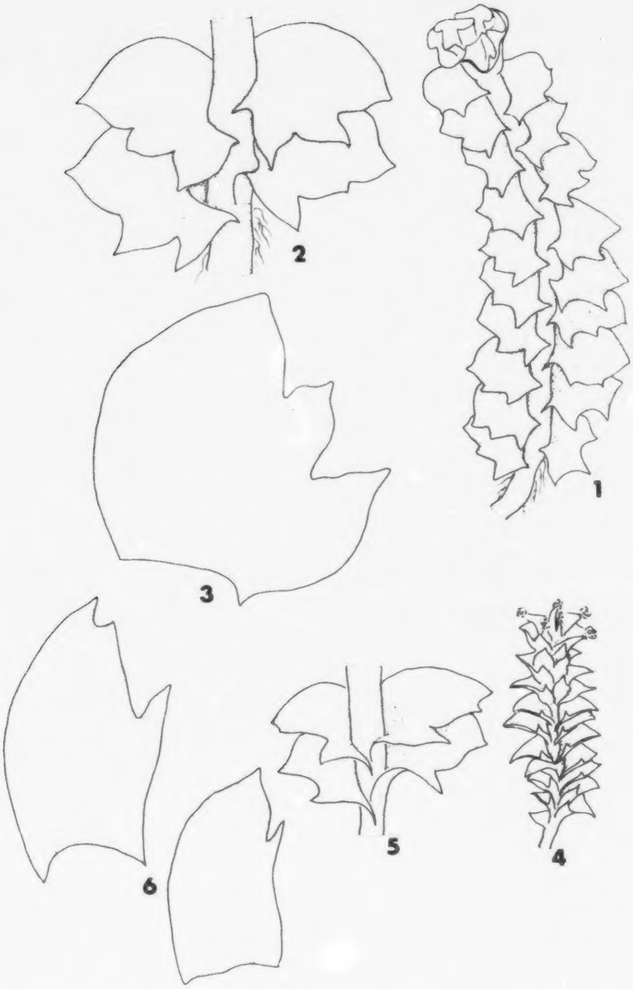

FIGURE 41. 1-3, **Tritomaria quinquedentata.** 1. Habit (x9). 2. Dorsal view of leaves (x18). 3. Leaf (x36). 4-6, **Tritomaria exsectiformis.** 4. Habit (x9). 5. Dorsal view of leaves (x18). 6. Leaves (x36).

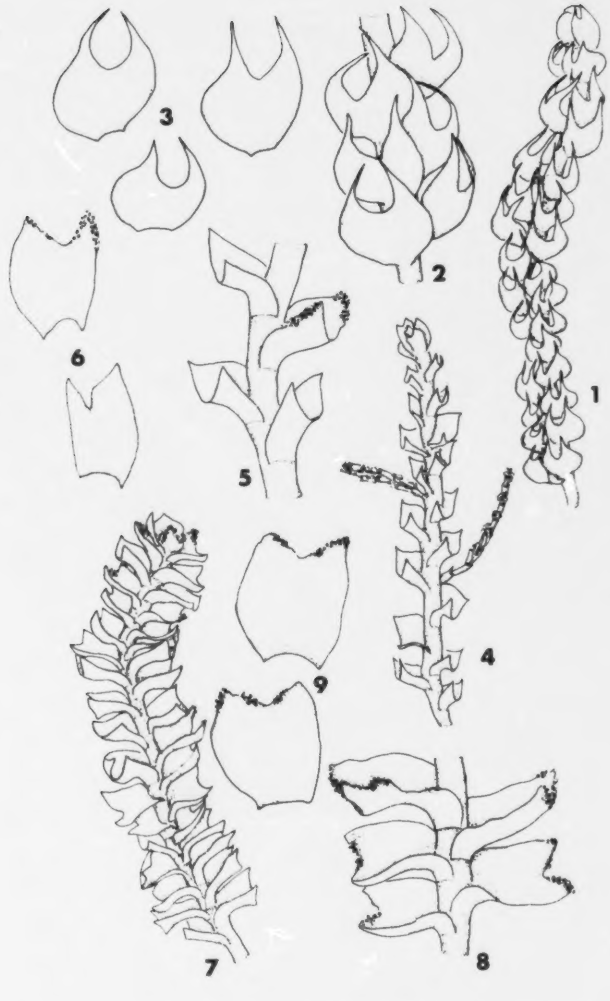

FIGURE 42. 1-3, **Nowellia curvifolia.** 1. Habit (x18). 2. Dorsal view of leaves (x36). 3. Leaves (x36). 4-6, **Anastrophyllum minutum.** 4. Habit (x18). 5. Dorsal view of leaves with gemmae (x36). 6. Leaves (x36). 7-9, **Anastrophyllum michauxii.** 7. Habit (x18). 8. Dorsal view of leaves with gemmae (x36). 9. Leaves (x36).

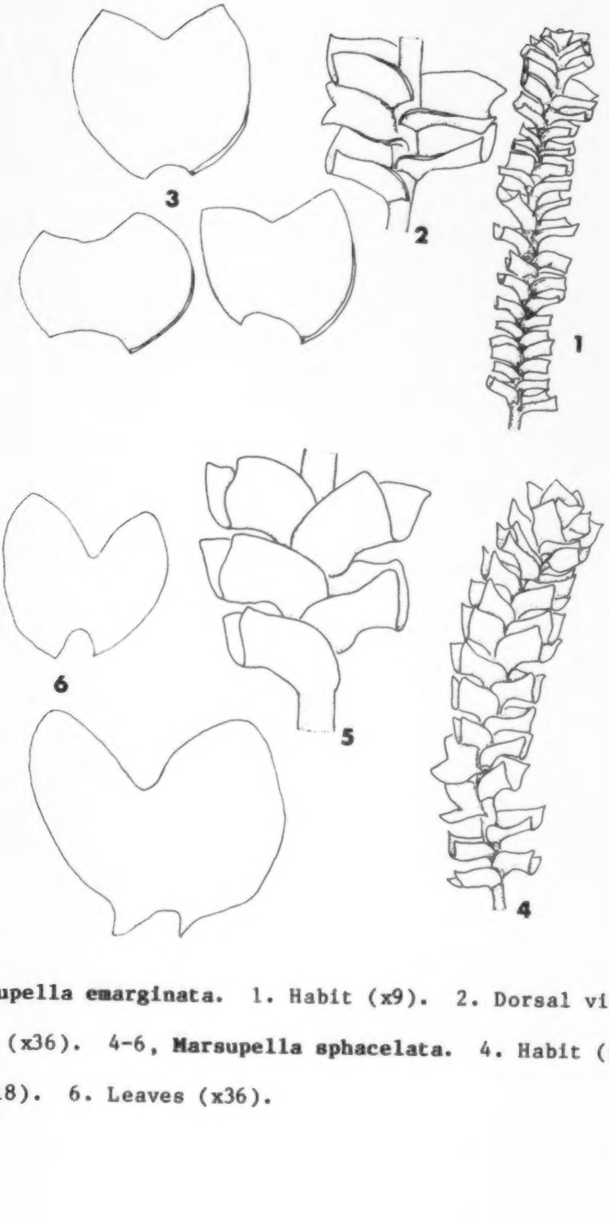

FIGURE 43. 1-3, **Marsupella emarginata.** 1. Habit (x9). 2. Dorsal view of leaves (x18). 3. Leaves (x36). 4-6, **Marsupella sphacelata.** 4. Habit (x9). 5. Dorsal view of leaves (x18). 6. Leaves (x36).

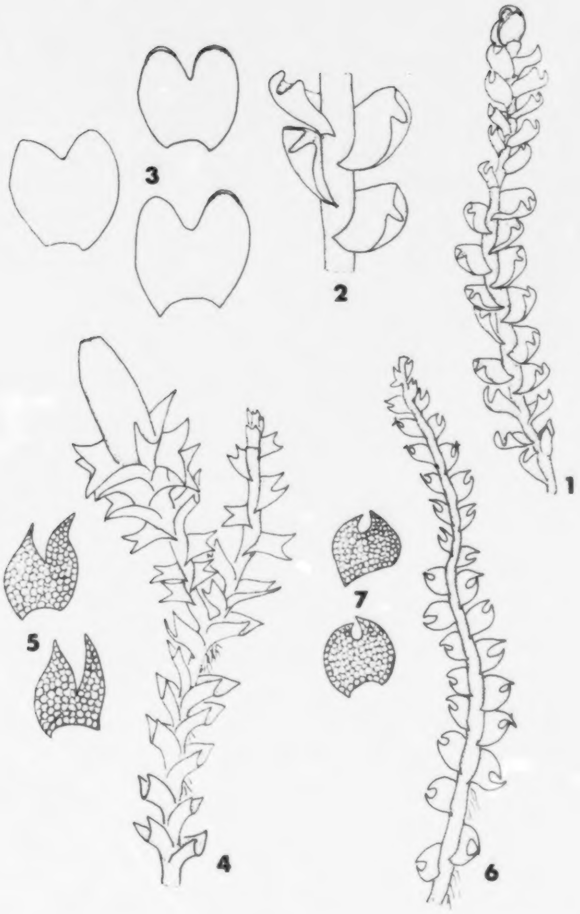

FIGURE 44. 1-3, **Gymnocolea inflata.** 1. Habit (x18). 2. Dorsal view of leaves (x36). 3. Leaves (x36). 4-5, **Cephalozia bicuspidata.** 4. Habit of plant with perianth (x18). 5. Leaves (x36). 6-7, **Cephalozia lunulifolia.** 6. Habit (x18). 7. Leaves (x36).

IV. Key to Mosses (Division Bryophyta)

1. Plants with 3-several branches in fascicles, the branches crowded near the stem apex to form a tuft; in bogs, swamps, lakes, wet depressions in woods, or other wet habitats..Sphagnum

SPHAGNUM
(Peat or Bog Moss)

A. Branches (as seen below stem apex) in fascicles of 6-13..S. wulfianum

Sphagnum wulfianum Girg. **Fig. 45: 6-9**
Over damp humus in boggy forests. NF to MB--GR to BC, south to PA, OH, MI, WI and MN.

A. Branches (as seen below stem apex) in fascicles of 4-6...B

B. Branch leaves squarrose, green or yellowish green...S. squarrosum

Sphagnum squarrosum Crome **Fig. 45: 1-5**
In wet coniferous woods, cedar swamps and at margins of streams. NF to MB--GR to AK, south in the mountains to NC and TN; also in OH, MI, IL, MN, CO, ID, AZ and CA.

B. Branch leaves not squarrose, usually reddish or purplish..C

C. Branch leaves cucullate, almost as broad as long...S. magellanicum

Sphagnum magellanicum Brid. **Fig. 46: 1-4**
In hummocks in open areas of bogs, sometimes in fens. NF to MB--GR to AK, south to FL, KY, IA, TX, ID and CA.

C. Branch leaves not cucullate, longer than broad..............S. capillifolium

Sphagnum capillifolium (Ehrh.) Hedw. **Fig. 46: 5-8**
In hummocks in bogs and fens and in wet depressions, on humus and wet rocks in woods. NF to MB--GR to AK, south to NC, MI, IN, WI, MN, AR, KS, CO, MT and WA.

1. Plants without branches in fascicles; often in dry habitats..........................2

2. Plants erect, small, stems less than 2 cm high, brown to reddish brown or black, leaves often without a costa; capsules eperistomate, opening most of their length by 4 longitudinal slits when dry; on noncalcareous rock.......................Andreaea

ANDREAEA

A. Leaves ovate to ovate-lanceolate, ecostate; common..A. rupestris

Andreaea rupestris Hedw. **Fig. 47: 1-5**
On exposed, acidic boulders and cliffs. NF to MB--GR to AK, south to GA, MI, MN, CO and northern CA.

A. Leaves narrowly lanceolate, costate; rare..........................A. rothii
Andreaea rothii Web. & Mohr **Fig. 47: 6-9**
On shaded, acidic boulders and cliffs. NF, NB, NS, ON--GR to ON and MI, south in the mountains to GA and TN; in the West from AK to northern CA.

2. Plants otherwise; capsules peristomate or eperistomate, opening by an operculum..3

3. Plants apparently lacking leaves; capsules large and prominent with a somewhat flattened upper surface, 5-7 mm long, on long, warty setae.....................................Buxbaumia aphylla
Buxbaumia aphylla Hedw. **Fig. 48: 1-4**
(Bug-on-a-Stick Moss)
A rare and unusual moss on humus in woods, soil under shrubs and on stumps and logs. NF to ON--NF to AK, south to NC, MI, IL, IA, CO, MT and WA.

3. Plants with conspicuous leaves; capsules usually smaller.............................4

4. Leaves in two distinct rows..5
4. Leaves in more than two rows..6

5. Leaves broad, often over 1 mm wide, with a flap fused onto the upper surface to form a large sheath......................Fissidens adiantoides
Fissidens adiantoides Hedw. **Fig. 49: 1-3**
In woods on moist soil banks, rotten logs, humus, woody debris, or often on calcareous rocks and cliffs beside streams, sometimes in the spray of waterfalls. NF to ON--GR to ON and MN, south to FL, LA and AR; in the West from AK to CA; also in WY.

5. Leaves narrow, less than 1 mm wide, lacking flap.................Distichium capillaceum
Distichium capillaceum (Hedw.) B.S.G. **Fig. 49: 4-6**
On calcareous rock, primarily in cliff crevices, sometimes on soil or humus over rock. NF to MB--GR to AK, south to NY, MI, IA, SD, NM, AZ and CA.

6. Plants with a large ovoid capsule, lacking seta and immersed among bristle-tipped leaves.........................Diphyscium foliosum
Diphyscium foliosum (Hedw.) Mohr **Fig. 48: 5-10**
(Grain of Wheat Moss)
On clay banks in woods and soil over rocks, often near creeks. NF to ON--NF to ON, south to GA, LA, AR and OK; also in AK and BC.

6. Plants usually with a small capsule and a prominent seta, or if lacking seta, capsule not ovoid and plants without bristle-tipped leaves.................................7

7. Plants greenish white, usually 3-6 cm high, in large, rounded, dense cushions on the ground; leaves close, tubulose.................Leucobryum glaucum

Leucobryum glaucum (Hedw.) Ångstr. ex Fries **Fig. 50: 1-4**
(Pin Cushion Moss)
On moist soil or humus, frequently on slopes in woods, occasionally in swampy woods or woods beside lakes. NF to MB--NF to MB, south to FL, MS, LA and OK.

7. Plants not greenish white or if so, not in dense cushions and without tubulose leaves..8

8. Plants in tufts and cushions, main stems erect, or nearly so, simple or with only a few branches, the branches sometimes short and tuft-like; costae usually prominent, single; sporophytes arising from stem apices or the apices of branches below (acrocarpous mosses)..............................9

8. Plants in mats, main stems prostrate or nearly so, sometimes with erect tips, usually much branched, often pinnate or rarely simple and if so, the stems long and intertwined; costae often indistinct, single, double or frequently lacking; sporophytes arising from main stem somewhere below apex (pleurocarpous mosses)..............................58

9. Gemmae cups (formed by apical leaves) present at the tips of gemmiferous shoots; capsules cylindric with 4 large peristome teeth; common, usually on rotten wood..............Tetraphis pellucida

Tetraphis pellucida Hedw. **Fig. 50: 5-10**
Usually on coniferous rotten wood, such as logs, tree trunks, stumps, sometimes on woody humus, rarely on moist sandstone. NF to MB--LB to AK, south to SC, AL, AR, SD, CO, AZ and CA.

9. Gemmae cups lacking; peristome teeth 16 or more; on various substrata...10

10. Leaves with lamellae on upper surface; peristome teeth attached by their tips to a membrane covering the mouth of the capsule..11

10. Leaves lacking lamellae; peristome teeth, if present, not attached to a membrane...13

11. Lamellae few, less than 10; leaves undulate, crisped or contorted when dry, costae narrow; calyptrae hispid, not hairy...Atrichum

ATRICHUM

A. Leaves broad, usually less than 4 times as long as wide, without teeth on back of lamina (sometimes a few teeth on back of costa)..........................A. crispum

Atrichum crispum (James) Sull. **Fig. 51: 1-3**
Usually on sandy soil along streams, in disturbed fields and roadside ditches, sometimes at margins of swamps. NB, NS, PE, QU, ON--NS to ON, south to FL, TN and IA.

A. Leaves narrow, usually more than 5 times as long as wide, with rows of teeth on back of lamina........................B

B. Plants small, stems up to 3 cm high, sparsely leaved, often producing sporophytes; usually in dry habitats in woodlands and along roads............................A. altecristatum

Atrichum altecristatum (Ren. & Card.) Smyth & Smyth **Fig. 51: 4-8**

On soil banks or hummocks, often in clearings in woodlands, frequently along roads or trails. NF to MB--NF to MB, south to NC, TN, AR and KS.

B. Plants large, stems up to 6 cm high, densely leaved, rarely producing sporophytes; mainly in wet habitats, along streams and at margins of swamps...................A. oerstedianum

Atrichum oerstedianum (C. Müll.) Mitt. **Fig. 52: 1-3**

On soil in moist, shaded habitats or in extremely wet habitats along streams, beside falls and at margins of swamps. NF to ON--LB to ON, south to NC, TN, MS and LA.

11. Lamellae numerous, more than 10; leaves rigid, not undulate, scarcely contorted when dry, costae broad; calyptrae hairy...12

12. Stems simple; leaves sometimes with a reddish or whitish awn; capsules 4-angled.....................................Polytrichum

POLYTRICHUM
(Hair-Cap Moss)

A. Leaf lamina with entire and infolded margins that cover lamellae..B

A. Leaf lamina with margins serrate to middle and not folded..D

B. Leaves ending in a whitish hair point.......................P. piliferum

Polytrichum piliferum Hedw. **Fig. 52: 4-8**

On sandy or gravelly soil in open, often disturbed sites, especially fields, roadbanks, and borrow pits. NF to MB--GR to AK, south to NC, TN, LA, CO, UT and CA.

B. Leaves ending in a reddish hair point (sometimes whitish at base)..C

C. Stems long, often over 5 cm high, commonly matted with whitish rhizoids; leaves erect-imbricate when dry; plants of bogs.........................P. strictum

Polytrichum strictum Brid. **Fig. 53: 1-5**

In bogs or at margins of bogs in hummocks, often among Sphagnum. NF to MB--GR to AK, south to GA, OH, MI, IL, MN, CO, MT and WA.

C. Stems short, seldom up to 5 cm, rhizoids scarcely noticeable; leaves spreading; plants of dry habitats.......................................P. juniperinum

Polytrichum juniperinum Hedw. **Fig. 53: 6-9**

Usually on soil or soil over rock in dry, open, mainly disturbed habitats, such as roadbanks, logged woodlands, pastures, etc. NF to MB--GR to AK, south to GA, AL, AR, KS, CO, AZ and CA.

D. Capsules short, about as long as wide..........................P. commune

Polytrichum commune Hedw. **Fig. 54: 1-5**
On soil or humus in bogs, wet woods, swamps, or sometimes drier habitats, such as trails and roadside banks. NF to MB--GR to AK, south to FL, MS, LA, TX, CO, AZ and CA.

D. Capsules elongate, definitely longer than wide..P. ohioense

Polytrichum ohioense Ren. & Card. **Fig. 54: 6-9**
On soil or humus over boulders, stumps and overturned tree roots in woodlands. NF to ON--NF to ON, south to GA, AL, MS, AR and OK; also in NM.

12. Stems simple or sometimes branched; leaves without awn; capsules terete..Pogonatum

POGONATUM

A. Plants large, stems 2-9 cm high, branched; on soil over boulders, cliff shelves and in cliff crevices..P. alpinum

Pogonatum alpinum (Hedw.) Röhl. **Fig. 55: 1-4**
On soil over boulders, cliff shelves and in cliff crevices, predominantly near streams in coniferous woods. NF to ON--GR to AK, south in the mountains and northern states to NC, WV, MI, MN, CO, UT, ID and CA.

A. Plants small, stems 0.1-0.6 cm high, simple; the persistent protonema forming a greenish coating on soil; on bare clay banks along roads, streams and in wooded clearings......................P. pensilvanicum

Pogonatum pensilvanicum (Hedw.) P. Beauv. **Fig. 55: 5-9**
On bare clay banks in open habitats, such as roadsides, streams and woodland clearings. NF to ON--NF to ON, south to FL, MS, LA and KS.

13. Leaves narrow, often subulate, 10-20 or more times as long as leaf width near middle; costae usually covering most of leaf near middle..14

13. Leaves broad, lanceolate, ovate, obovate or oblong, mostly less than 10 times as long as broad; costae often covering only a small portion of leaf near middle.............................24

14. Leaves squarrose, with an enlarged base clasping the stem; capsules horizontal, strumose; usually on wood..Oncophorus wahlenbergii

Oncophorus wahlenbergii Brid. **Fig. 56: 1-4**
On rotten logs, stumps and tree bases, or sometimes on soil or humus over rock, in coniferous woods. NF to MB--GR to AK, south to WV, MI, MN, SD, CO, MT and BC.

14. Leaves not squarrose or if squarrose, without enlarged clasping base; capsules erect to horizontal, struma lacking or indistinct; on a variety of substrata..15

15. Alar cells noticeably differentiated, often inflated and red or orange..........16

15. Alar cells not noticeably differentiated..........18

16. Leaves short, about 3 mm long, entire; stems short, about 2 cm high, red; capsules rare, short, pyriform; on rock along streams and near waterfalls..........Blindia acuta

Blindia acuta (Hedw.) B.S.G. **Fig. 56: 5-7**
On wet boulders, cliff faces and ledges, frequently near waterfalls. NF to ON--GR to AK, south in the mountains and northern states to SC, TN, MI, WI, MN, CO, MT, ID and CA.

16. Leaves long, mostly more than 3 mm, serrate on margins and back of costa; stems long, nearly always more than 2 cm high, usually green or brown; capsules common, long, cylindric; on rock or various substrata..........17

17. Costae broad, occupying about 2/3 of leaf at base and nearly all the leaf near the middle; capsules straight, erect; usually on rock..........Paraleucobryum longifolium

Paraleucobryum longifolium (Hedw.) Loeske **Fig. 57: 1-3**
Usually on soil over acidic boulders and cliffs, sometimes on tree trunks, stumps and logs. NF to MB--GR to AK, south in the mountains and northern states to GA, TN, MI, WI, MN, SD, NM and AZ.

17. Costae narrow, occupying about 1/3 of leaf at base and usually less above; capsules straight to arcuate, erect or inclined; on various substrata..........Dicranum

DICRANUM

A. Plants with sporophytes often clustered in the perichaetia..........B

A. Plants with sporophytes solitary in the perichaetia..........C

B. Leaves strongly undulate, glossy, margins strongly toothed in upper half..........D. polysetum

Dicranum polysetum Sw. **Fig. 57: 4-7**
On soil or humus in woodlands, sometimes in swamps and at margins of bogs. NF to MB--NF to AK, south to NC, MI, IL, MO, SD, WY and WA.

B. Leaves smooth or weakly undulate, dull, margins weakly toothed..........D. ontariense

Dicranum ontariense Peters. **Fig. 59: 1-4**
On humus in coniferous woods, rarely at margins of bogs. NF to MB--NF to SA, south to ME, NH, NY, OH, MI, WI and MN.

C. Capsules straight, erect; 1-6 terete, microphyllous branchlets often present in some leaf axils..........D. flagellare

Dicranum flagellare Hedw. **Fig. 59: 5-7**

Commonly on rotting stumps and logs, rarely on humus or soil over rock. NF to MB--LB to BC, south to FL, AL, LA, SD and MT.

C. Capsules curved, inclined to horizontal; microphyllous branchlets lacking..D

D. Leaves often over 6 mm long, strongly serrate on margins and back of costa, scarcely crisped when dry; capsules long, often over 3 mm, nonstrumose..........................D. scoparium

Dicranum scoparium Hedw. **Fig. 58: 1-3**

(Broom Moss)

Usually on soil or humus in forests, sometimes on rotting logs and stumps or humus over rock. NF to MB--GR to AK, south to FL, AL, LA, SD, NM, AZ and OR.

D. Leaves usually less than 6 mm long, weakly serrate, strongly crisped when dry; capsules short, seldom reaching 3 mm, often strumose......................................D. fuscescens

Dicranum fuscescens Turn. **Fig. 58: 4-6**

Commonly on rotten stumps or logs, sometimes on bases of trees, soil or humus on banks or over boulders, rarely in hummocks in bogs. NF to MB--GR to AK, south to NC, TN, MI, WI, MN, MB, SA, NM, ID and CA.

18. Capsules distinctly narrowed at neck that is nearly as long as the urn (especially noticeable when dry); leaves entire..19

18. Capsules not narrowed at neck; leaves entire or serrate...20

19. Capsules cylindric, strumose, erect to somewhat inclined...Trematodon ambiguus

Trematodon ambiguus (Hedw.) Hornsch. **Fig. 60: 1-3**

(Long-Necked Moss)

On predominantly clay soil in open disturbed sites, especially roadside banks and ditches, clearings in woods, stream banks and fields. NF to ON--LB to ON, south to NH, NY, PA, MI, WI and MN; also in AK and BC.

19. Capsules pyriform, not strumose, horizontal to pendulous...Leptobryum pyriforme

Leptobryum pyriforme (Hedw.) Wils. **Fig. 60: 4-6**

On soil, rock or rotten wood, often in burned-over or disturbed habitats; common in greenhouses. NF to MB--Throughout most of North America.

20. Leaves with recurved, serrate margins; capsules globose or nearly so...21

20. Leaves with plane or incurved margins, entire or indistinctly serrate near apex; capsules cylindric..22

21. Leaves light green, mostly 4 mm long or more, crisped and contorted when dry, base sheathing stem; common, on noncalcareous rock.......................................Bartramia pomiformis

Bartramia pomiformis Hedw. **Fig. 61: 1-4**
(Apple Moss)
On soil or humus over boulders, on cliff ledges or in crevices, often along streams. NF to MB--GR to AK, south to GA, AL, AR, OK, MT and OR.

21. Leaves dark green to yellowish green, seldom reaching 4 mm in length, weakly contorted when dry, base not sheathing stem; frequent, on calcareous rock...Plagiopus oederiana

Plagiopus oederiana (Brid.) Limpr. **Fig. 61: 5-8**
On calcareous cliffs and boulders, especially along streams. NF to ON--GR to AK, south to VA, IN, IA, CO, ID and OR.

22. Leaves with a V-shaped region of hyaline cells at base, dorsal surface with a dull lamina and a distinctly shiny costa, many leaves with broken tips and missing portions..Tortella

TORTELLA

A. Leaves with upper portion often broken off......................T. fragilis

Tortella fragilis (Drumm.) Limpr. **Fig. 62: 1-2**
On calcareous soil or rock, often on cliff ledges or in crevices. NF to MB--GR to AK, south to NJ, NC, TN, IA, NE, CO, ID and OR.

A. Leaves usually intact.. T. tortuosa

Tortella tortuosa (Hedw.) Limpr. **Fig. 62: 3-6**
A calciphile usually on cliffs, rock outcrops and boulders, rarely on soil over rotten stumps. NF to MB--GR to AK, south to NC, TN, MI, IL, IA, SD, CO, UT, ID and OR.

22. Leaves lacking V-shaped region of cells and differentiated lamina and costa, seldom broken..............................23

23. Peristome teeth filiform, capsules not contracted under mouth when dry...Ditrichum

DITRICHUM

A. Stems usually tomentose, often over 1 cm high; leaves 2-7 mm long; sporophytes rarely produced; on calcareous rock or soil over rock..........................D. flexicaule

Ditrichum flexicaule (Schwaegr.) Hampe **Fig. 63: 1-3**
On calcareous soil or rock, especially on bluffs, cliff shelves or in cliff crevices. NF to MB--GR to AK, south to NS, VT, MI, MN, IA, CO, ID and WA.

A. Stems not tomentose, seldom reaching 1 cm high; leaves 1-2 mm long; sporophytes common; on acidic soil banks..................................D. lineare

Ditrichum lineare (Sw.) Lindb. **Fig. 63: 4-6**

Frequently on clay, sand or gravelly soil banks in wooded clearings, along trails, roads or in other disturbed habitats. NF to ON--LB to ON, south to FL, TN, IN and AR.

23. Peristome teeth lanceolate, capsules usually contracted under mouth when dry..Dicranella

DICRANELLA

A. Capsules strongly contracted under a portion of mouth when dry; setae yellow to brown......................D. heteromalla

Dicranella heteromalla (Hedw.) Schimp. **Fig. 64: 1-3**

On soil banks in woods and along roads, sometimes on hummocks in woods or on soil over stumps and logs, occasionally in rock crevices or soil pockets of boulders especially along streams. NF to MB--NF to MB, south to FL and TX; in the West from AK to CA.

A. Capsules scaracely contracted under mouth when dry; setae red..D. varia

Dicranella varia (Hedw.) Schimp. **Fig. 64: 4-6**

On clay or sandy and gravelly soil banks along rivers, roads or in woods. NF to MB--GR to AK, south to FL, TN, LA, OK, NM and CA.

24. Alar cells strongly differentiated, inflated often red or orange..Dicranum (See p. 83)
24. Alar cells not noticeably differentiated...25

25. Leaves entire or nearly so at apex..26
25. Leaves serrate or toothed at apex...41

26. Leaves with a differentiated marginal border of a lighter colour and often thickness than the lamina..............................27
26. Leaves lacking differentiated border...28

27. Leaves lanceolate to ovate or oblong-lanceolate, seldom more than 1 mm wide, acute to acuminate, often with a long-excurrent costa..Bryum

BRYUM

A. Plants silvery-white, stems short, 0.4-1.0 cm high, leaves nondecurrent, costae ending below apices...........B. argenteum

Bryum argenteum Hedw. **Fig. 65: 1-3**

On predominantly dry soil in disturbed habitats, especially in cracks of sidewalks, along paths, roads and railroads. NF to MB--Throughout most of North America.

A. Plants green or sometimes brownish or reddish, stems long, 2-6 cm high, leaves long-decurrent, costae percurrent to short-excurrent..B. pseudotriquetrum

Bryum pseudotriquetrum (Hedw.) Gaertn., Meyer & Scherb. **Fig. 65: 4-6**

On wet, often sandy soil or humus beside roads, streams or lakes, sometimes on wet boulders and rock ledges that are frequently calcareous, and occasionally on decayed wood in swamps. NF to MB--GR to AK, south to FL, AL, AR, OK, CO, AZ and CA.

27. Leaves obovate to rounded ovate, usually more than 1 mm wide, costa ending below apex or in a short, blunt mucro..Rhizomnium

RHIZOMNIUM

A. Plants large, stems often over 5 cm high and leaves 5-11 mm long; costae often percurrent; rhizoids scattered along lower part of stems..R. appalachianum

Rhizomnium appalachianum Kop. **Fig. 66: 1-2**

On wet soil or humus, primarily in swampy forests but often on stream banks and margins of lakes. NF to MB--LB to MB, south to GA, TN, MI, WI and MN.

A. Plants small, stems seldom reaching 5 cm high and leaves 3-6 mm long; costae subpercurrent; rhizoids restricted to leaf axils in lower part of stems...............................R. punctatum

Rhizomnium punctatum (Hedw.) Kop. **Fig. 66: 3-5**

On soil, humus, rotten logs and stumps, bases of trees, boulders and cliffs, in woodlands often beside creeks. NF to ON--NF to ON, south to GA, TN and AR; also in BC.

28. Plants on tree trunks, often in small rounded tufts, rarely on fallen trees or rotting logs..................................29

28. Plants on soil, rock, humus, sometimes at bases of trees and over rotting logs but not on tree trunks.............................30

29. Leaves obtuse, margins plane; capsules immersed..............Orthotrichum obtusifolium

Orthotrichum obtusifolium Brid. **Fig. 67: 4-7**

Usually on deciduous tree trunks, especially elm, maple, poplar and willow, rarely on coniferous trunks. NF to MB--LB to AK, south to NC, TN, MI, MN, NM and CA.

29. Leaves acute, margins recurved; capsules exserted...............................Ulota

ULOTA

A. Plants with leaves strongly crisped when dry; occurring on tree trunks and limbs.........................U. crispa

Ulota crispa (Hedw.) Brid. **Fig. 68: 1-4**

On tree trunks and limbs. NF to MB--NF to SA, south to GA, AL, IL and MN.

A. Plants with leaves straight, curved or twisted but not crisped when dry; occurring on tree trunks and limbs or rock..........B

B. Plants on tree trunks and limbs; capsules pyriform, with a small, puckered mouth when dry..........U. coarctata

Ulota coarctata (P. Beauv.) Hamm. **Fig. 68: 5-8**
On tree trunks and limbs. NF to ON--LB to ON, south to GA, NC and TN.

B. Plants on rock; capsules cylindric, without a puckered mouth..........U. hutchinsiae

Ulota hutchinsiae (Sm.) Hamm. **Fig. 68: 9-11**
Usually on noncalcareous rock in forests. NF to ON--NF to ON, south to GA, AL, AR and OK.

30. Leaves obtuse (at least the leaves near the stem tips) to broadly acute..........31
30. Leaves acute to acuminate..........32

31. Capsules exserted above leaves on a long seta; peristome teeth filamentous, long and twisted; on soil..........Barbula convoluta

Barbula convoluta Hedw. **Fig. 69: 1-4**
On calcareous soil in open, disturbed habitats, such as roadsides, gravel pits and fields. NF to MB--NF to AK, south to GA, TN, MI, AR, MT and CA.

31. Capsules immersed on a short seta; peristome teeth lanceolate, short and not twisted; on rock in or beside streams or beside ocean..........Schistidium

SCHISTIDIUM

A. Leaves ovate-lanceolate, acute or acuminate, rarely narrowly obtuse, often with a hyaline mucro or awn..........B
A. Leaves ligulate to linear-lanceolate, narrowly obtuse to broadly acute, lacking hyaline tip..........C

B. Leaves usually with a long awn, 1/4 the length of leaf or more, dorsal surface of costa often rough near apex..........S. apocarpum

Schistidium apocarpum (Hedw.) B. & S. in B.S.G. **Fig. 70: 1-4**
On exposed, usually dry, calcareous or noncalcareous rock. NF to MB--GR to AK, south to GA, AL, LA, TX, NM, AZ and CA.

B. Leaves lacking awn or awn very short, dorsal surface of costa smooth..........S. rivulare

Schistidium rivulare (Brid.) Podp. **Fig. 70: 5-8**
On exposed boulders or rock ledges in or beside streams, sometimes in dry woods. NF to ON--GR to AK, south to NC, KY, LA, KS, NM, AZ and CA.

C. Leaf apices narrowly obtuse, sometimes acute, leaves not eroded; maritime plants growing on rocks in the spray zone............................S. maritimum

Schistidium maritimum (Turn.) B. & S. in B.S.G. **Fig. 71: 1-3**

On boulders and in cliff crevices in the spray zone beside the ocean. NF, NB, NS, QU--Along the east coast from LB to MA and the west coast from AK to CA.

C. Leaf apices broadly obtuse to broadly acute, the leaves often eroded; plants not maritime, on rocks in or by streams and lakes..........................S. agassizii

Schistidium agassizii Sull. & Lesq. ex Sull. **Fig. 71: 4-6**

On acidic boulders in or beside streams, often near waterfalls. NF to ON--LB to ON, south to ME, NY and MI; in the West from AK and YT, south to CA, UT and CO.

32. Plants nearly julaceous, mostly silvery-white due to an absence of chlorophyll in cells..............Bryum argenteum (See p. 86)
32. Plants neither julaceous nor silvery-white..................................33

33. Leaf margins inrolled when dry....................................Weissia controversa

Weissia controversa Hedw. **Fig. 72: 1-3**

On soil, soil over rock, or in rock crevices in disturbed, exposed habitats, especially roadside banks and fields. NF to MB--NF to AK, south to FL, LA, TX, AZ, NM and CA.

33. Leaf margins recurved or plane when dry...34

34. Capsules inclined to pendulous, sulcate, ribbed or wrinkled when dry..35
34. Capsules erect, smooth or ribbed when dry...37

35. Leafy plants bulbiform; setae flexuose; capsules pyriform...Funaria hygrometrica

Funaria hygrometrica Hedw. **Fig. 72: 4-7**
(Cord Moss)

A common weed in disturbed habitats, especially on burned wood, on soil in roadside ditches, and on soil in greenhouses. NF to MB--Throughout all of North America.

35. Leafy plants not bulbiform; setae straight or nearly so; capsules cylindric...36

36. Leaves green, with some red or purple colouration near the base; pseudopodia lacking; capsules and setae red or purple.......................................Ceratodon purpureus

Ceratodon purpureus (Hedw.) Brid. **Fig. 73: 1-3**

An extremely common, weedy species found in disturbed habitats on soil, rock, wood and humus. NF to MB--GR to AK, south to NC, TN, AR, TX, NM, AZ and CA.

36. Leaves yellowish green, without red or purple colour; pseudopodia often present with gemmae attached; capsules and setae yellow or brown, sometimes reddish brown..Aulacomnium

AULACOMNIUM

A. Medium-sized to robust plants, stems 3-9 cm high; pseudopodia present on some plants, bearing elongated clusters of leaf-like gemmae at apices, often with only naked pseudopodia after gemmae have fallen............................A. palustre

Aulacomnium palustre (Hedw.) Schwaegr. **Fig. 73: 4-8**
(Ribbed Bog Moss)
On soil or humus, sometimes on rotting logs, often in bogs, swamps, at lake margins, beside streams or in other wet habitats. NF to MB--Throughout Canada and U.S.

A. Small plants, stems 1-4 cm high; pseudopodia with round clusters of gemmae at apices present on some plants.......................................A. androgynum

Aulacomnium androgynum (Hedw.) Schwaegr. **Fig. 73: 9-11**
Generally in dry habitats, on soil or humus in coniferous woodlands, often over rock, sometimes on decaying wood. NF to ON--NF to ON, south to WV, MI, IL, WI and MN; in the West from AK to AT, south to CA, UT and WY.

37. Leaves mucronate, the mucro often yellowish....................................38
37. Leaves blunt to acute...40

38. Leaf margins recurved.......................................Barbula unguiculata

Barbula unguiculata Hedw. **Fig. 69: 5-6**
On calcareous soil or soil over rock, in open, usually disturbed habitats, especially roadsides and woodland trails. NF to MB--NF to BC, south to FL, LA, OK, NM, UT and CA.

38. Leaf margins plane...39

39. Capsules obovate, opercula oblique, calyptrae cucullate, peristome absent; plants on soil, often in open, weedy habitats, such as roadsides, lawns, gardens, fields and pastures...Pottia truncata

Pottia truncata (Hedw.) Fürnr. ex B.S.G. **Fig. 74: 1-3**
On bare, often calcareous, soil in open, usually disturbed habitats, such as fields, pastures, lawns and roadsides. NB, NS, QU, ON--NS to ON, south to MD and MI; also in BC and WA.

39. Capsules cylindric, opercula straight, calyptrae mitrate, peristome present; plants on rock, usually in woodlands...Encalypta ciliata

Encalypta ciliata Hedw. **Fig. 74: 4-6**
(Extinguisher Moss)
On ledges or in crevices of calcareous bluffs or cliffs, sometimes on soil over boulders. NF to MB--GR to ON, south to PA, MI, IA and NE; in the West from AK to YT, south to CA, AZ and NM.

40. Leaf apices sometimes blunt; capsules with 16 ribs, 8 long ones alternating with 8 short ones; occurring on calcareous rock.................................Orthotrichum anomalum

Orthotrichum anomalum Hedw. **Fig. 67: 1-3**
Commonly on calcareous rocks. NF to MB--LB to AK, south to NC, OH, IL, IA, SD, NM, AZ and BC.

40. Leaf apices acute; capsules with 8 ribs of about the same length; occurring on noncalcareous rock.................................Ulota hutchinsiae (See p. 88)

41. Capsules globose, subglobose or pyriform...42
41. Capsules cylindric to ovoid..43

42. Plants large, 3-8 cm high; capsules inclined, ribbed when dry, peristome present...............................Philonotis fontana

Philonotis fontana (Hedw.) Brid. **Fig. 75: 4-7**
(Fountain Apple Moss)
On soil, often over rock, in wet places, especially roadside ditches and along streams. NF to MB--GR to AK, south to NC, TN, AR, TX, NM, AZ and CA.

42. Plants small, less than 3 cm high; capsules erect, smooth or wrinkled at base when dry, peristome lacking.......................................Physcomitrium pyriforme

Physcomitrium pyriforme (Hedw.) Hampe **Fig. 75: 1-3**
(Urn Moss)
Occurring in the spring on moist, bare, exposed soil, in disturbed habitats, such as stream banks, roadside ditches, lawns, pastures and meadows. NB, NS, QU, ON, MB--NS to AT, south to FL, MS, LA, TX and CO.

43. Leaves with a differentiated border, the border of a lighter colour and often thicker than the lamina.....................................44
43. Leaves lacking differentiated border...47

44. Leaves with hyaline, irregularly toothed border in upper part of leaf...........................Rhacomitrium lanuginosum (See p. 94)
44. Leaves without a hyaline border...45

45. Leaves crowded at stem apices forming rosettes; plants connected by subterranean stems...........................Rhodobryum ontariense

Rhodobryum ontariense (Kindb.) Kindb. **Fig. 76: 4-6**
On humus, rotting logs, bases of trees and soil, often over limestone. NF, NB, NS, QU, ON--NF to ON, south to NC, TN, AR, OK and AZ; also in AT.

45. Leaves not crowded into rosettes and plants not connected by subterranean stems..46

46. Leaf borders with teeth in pairs; costae red, especially near base of leaves; stoloniferous shoots absent...........................Mnium

MNIUM

A. Leaf margins without differentiated border of cells, singly serrate or a few teeth in pairs...M. stellare

Mnium stellare Hedw. **Fig. 76: 1-3**
On soil over rock, sometimes limestone, on banks and on bases of trees. NF, NB, NS, QU, ON--NF to ON, south to NC, TN and AR.

A. Leaf margins with differentiated border of cells, doubly serrate....................B

B. Costae toothed above on dorsal surface....................M. ambiguum
Mnium ambiguum H. Müll. **Fig. 77: 4-6**
On soil on bluffs and cliffs, often sandstone and limestone, and on bases of conifers. NF, PE, QU, ON, MB--LB to AK and BC, south to NC, MI, AR and NM.

B. Costae smooth on dorsal surface....................C

C. Leaves scarcely reaching 1.5 mm wide; plants seldom with sporophytes; peristome teeth yellow to light brown....................M. marginatum
Mnium marginatum (With.) Brid. ex P. Beauv. **Fig. 77: 1-3**
On soil, frequently over calcareous bluffs and cliffs, sometimes on humus and bases of trees. NF, NB, NS, QU, ON--LB to AK, south to NC, TN, AR, CO, AZ and OR.

C. Leaves often over 1.5 mm wide and up to 3 mm wide; plants usually with sporophytes; peristome teeth red to purplish brown....................M. spinulosum
Mnium spinulosum B.S.G. **Fig. 78: 1-3**
On humus, rotten logs and stumps, bases of trees, sometimes on sandstone. NB, NS, PE, QU, ON, MB--LB to AK, south to MD, MI, WI, MN, CO and WA.

46. Leaf borders with single teeth; costae yellow or green; stoloniferous shoots present....................Plagiomnium

PLAGIOMNIUM

A. Leaves obovate, margins toothed to middle....................P. cuspidatum
Plagiomnium cuspidatum (Hedw.) Kop. **Fig. 78: 4-6**
On soil, humus, rocks, bases of trees, rotten logs and stumps in woodlands. NF to MB--LB to AK, south to FL, MS, LA, TX, CO, AZ and OR.

A. Leaves elliptic, margins toothed nearly to base....................B

B. Plants with sporophytes solitary in the perichaetia; occurring in moderately dry habitats....................P. ciliare
Plagiomnium ciliare (C. Müll.) Kop. **Fig. 79: 1-4**
On soil, humus, rocks, bases of trees, rotten logs and stumps in woodlands. NF to MB--LB to AK, south to FL, AL, LA, TX and MT.

B. Plants with sporophytes clustered (1-4) in the perichaetia; occurring in swampy or wet habitats....................P. medium

Plagiomnium medium (B.S.G.) Kop. **Fig. 79: 5-7**
On soil, humus, rocks, often in wet depressions in woods. NF to MB--GR to AK, south to TN, AR, CO, AZ and CA.

47. Leaves broad, often over 3 mm wide..........................Pseudobryum cinclidioides

Pseudobryum cinclidioides (Hüb.) Kop. **Fig. 80: 5-7**
On soil or humus in swamps or in wet depressions in woodlands, sometimes on boulders or exposed tree roots. NF to MB--GR to AK, south to VA, MI, MN and MT.

47. Leaves narrow, less than 3 mm wide..48

48. Leaves ending in a long hyaline point or awn; capsules cylindric, erect, immersed or exserted....................................49

48. Leaves without hyaline point or awn; capsules cylindric to ovoid, erect to pendulose, exserted....................................51

49. Hyaline points long, often reaching 1 mm or more; peristome with a basal tube and twisted teeth above....................Tortula ruralis

Tortula ruralis (Hedw.) Gaertn., Meyer & Scherb. **Fig. 80: 1-4**
On soil or rocks in dry, sunny, calcareous habitats, often on sand near shores of lakes. NF, NS, QU, ON, MB--GR to AK, south to NY, MI, MO, SD, NM, AZ and CA.

49. Hyaline points short, usually less than 1 mm or if longer, the margins toothed below the point; peristome without basal tube and teeth not twisted....................................50

50. Plants with short, tuft-like branches; capsules exserted....................................Rhacomitrium

RHACOMITRIUM

A. Leaves with an obtuse, nonhyaline apex........................R. aciculare

Rhacomitrium aciculare (Hedw.) Brid. **Fig. 82: 1-3**
On sandy soil over rock in or beside streams and lakes. NF, NB, NS, QU, ON--LB to ON, south to GA and TN; in the West from AK to BC, south to CA, ID and MT.

A. Leaves with an acute, hyaline apex....................................B

B. Hyaline leaf apices entire or indistinctly toothed; plants yellowish green above, dark green to brown or black below......................R. heterostichum

Rhacomitrium heterostichum (Hedw.) Brid. **Fig. 82: 4-6**
On sandy soil on mainly acidic boulders and cliffs, often beside streams and lakes. NF, NB, NS, QU, ON--LB to ON, south to GA, TN, MI and MN; in the West from AK to AT, south to CA, ID and CO.

B. Hyaline leaf apices distinctly toothed; plants yellowish green to grayish green above, light brown to blackish below....................................C

C. Hyaline leaf apices extending down margins as decurrencies, strongly toothed; plants grayish green..*R. lanuginosum*

Rhacomitrium lanuginosum (Hedw.) Brid. **Fig. 81: 1-3**
(Woolly Fringe Moss)
On dry, exposed, acidic soil or rock. NF, NS, QU, ON, MB--GR to AK, south to NH, NY, MT, ID and CA.

C. Hyaline leaf apices not extending down margins as decurrencies, weakly toothed; plants yellowish green to light brown..........................*R. canescens*

Rhacomitrium canescens (Hedw.) Brid. **Fig. 81: 4-5**
In exposed habitats on sandy soil over rock or on sand or gravel beside lakes. NF, NB, NS, QU, ON, MB--GR to AK, south to NH, NY, MI, CO, ID and CA.

50. Plants with unbranched stems or with long branches; capsules immersed..............................*Schistidium* (See p. 88)

51. Plants with a whitish, filamentous or cobwebby substance on leaves..*Saelania glaucescens*

Saelania glaucescens (Hedw.) Bomanss. & Broth. **Fig. 83: 1-5**
On soil on steep banks or in rock crevices. NF, NB, NS, QU, ON, MB--GR to AK, south to NY, MI, MN, IA, CO, AZ and BC.

51. Plants lacking whitish substance on leaves....................................52

52. Leaf margins recurved...53
52. Leaf margins plane or incurved...56

53. Capsules sulcate or ribbed when dry..54
53. Capsules smooth or indistinctly wrinkled...................................55

54. Leaves often reddish or purplish, especially at base; pseudopodia lacking; capsules and setae purplish...............................*Ceratodon purpureus* (See p. 89)

54. Leaves green to yellowish brown; pseudopodia often present with gemmae attached; capsules and setae yellow or brown, sometimes reddish brown...................*Aulacomnium* (See p. 90)

55. Gametophytes large, often over 1 cm high, leaves broad, 0.5 mm or more wide; on rock in or beside streams..*Rhacomitrium aciculare* (See p. 93)

55. Gametophytes small, mostly less than 1 cm high, leaves narrow, less than 0.5 mm wide; in various habitats, on soil, wood or rock.......................*Bryoerythrophyllum recurvirostrum*

Bryoerythrophyllum recurvirostrum (Tayl.) Chen **Fig. 83: 6-8**
Commonly on calcareous soil over boulders and cliff ledges, sometimes on rotten logs and stumps. NF, NB, NS, QU, ON--GR to AK, south to NJ, NC, MI, AR, TX, NM, AZ and CA.

56. Stems and costae red, leaves bluish-green...............*Mnium stellare* (See p. 92)
56. Stems and costae not red, leaves not bluish-green.............................57

57. Leaves often 5 mm long or more, margins inrolled when dry; calyptrae remaining attached to setae just below capsule..Timmia megapolitana

Timmia megapolitana Hedw. **Fig. 84: 1-3**
On moist soil or humus, on shaded banks along creeks or in swamps. NS, QU, ON, MB--NS to AK, south to VA, MI, IL, AR, KS, SA, AT and BC.

57. Leaves less than 5 mm long, margins plane; calyptrae not remaining attached to setae..Pohlia

POHLIA

A. Plants yellowish green to dark green; leaf margins recurved; capsules elongate..........................P. nutans

Pohlia nutans (Hedw.) Lindb. **Fig. 84: 4-6**
On soil, humus, rotten logs and stumps in clearings in woodlands, sometimes in bogs. NF to MB--GR to AK, south to GA, AR, KS, CO, AZ and CA.

A. Plants whitish green; leaf margins plane; capsules elongate or short and nearly as broad as long............................B

B. Leaves glossy, often with opalescent patches; capsules elongate...................................P. cruda

Pohlia cruda (Hedw.) Lindb. **Fig. 85: 1-3**
On soil or humus, often on shaded rock ledges or in crevices of cliffs, sometimes on rotten logs. NF to MB--GR to AK, south to TN, MI, IA, CO, AZ and CA.

B. Leaves dull, lacking opalescent patches; capsules short, nearly as broad as long..................P. wahlenbergii

Pohlia wahlenbergii (Web. & Mohr) Andr. **Fig. 85: 4-6**
On soil in exposed and disturbed habitats, sometimes beside streams. NF to MB--GR to AK, south to NC, TN, AR, NE, NM, AZ and CA.

58. Leaves strongly rugose when dry, falcate-secund, margins recurved..Rhytidium rugosum

Rhytidium rugosum (Hedw.) Kindb. **Fig. 86: 1-3**
On dry, exposed, calcareous rocks and cliffs. NF, NS, QU, ON, MB--GR to AK, south to NC, TN, MO, SD, CO and AZ.

58. Leaves not rugose..59

59. Plants complanate, leaves appearing distichous, oblong, falcate, apices rounded..............................Homalia trichomanoides

Homalia trichomanoides (Hedw.) B.S.G. **Fig. 86: 4-6**
On calcareous rock ledges, bluffs, shaded faces of cliffs and occasionally on bases of trees. NF to ON--LB to ON, south to NC, MS and AR; also in BC, WA, OR and AZ.

59. Plants not complanate or if so, leaves not oblong with rounded apices...60

60. Leaves with a single costa...61

60. Leaves lacking costa or costa double (usually divided at base)...84

61. Plants dendroid and erect..62
61. Plants not dendroid...63

62. Branches covered with paraphyllia that give them a whitish or brownish cobwebby appearance; plants on humus in wet, often swampy habitats..................Climacium dendroides

Climacium dendroides (Hedw.) Web. & Mohr **Fig. 87: 1-4**
(Tree Moss)
On wet soil and humus in swamps, along streams, beside pools in woods and on shady, damp rocks. NF to MB--GR to AK, south to VA, IL, MN, NM, AZ and CA.

62. Branches lacking paraphyllia; plants on rock and not in swampy habitats...............................Thamnobryum alleghaniense

Thamnobryum alleghaniense (C. Müll.) Nieuwl. **Fig. 87: 5-7**
On wet rock ledges beside creeks and on humus over rock. NB, NS, QU, ON--NS to ON, south to GA, AL, MS and AR.

63. Apices of many branches with clusters of microphyllous branchlets...Leskeella nervosa

Leskeella nervosa (Brid.) Loeske **Fig. 88: 1-3**
On tree trunks, rotten logs and calcareous rocks. NF, NB, NS, QU, ON, MB--GR to AK, south to NC, PA, MI, MN, NM and AZ.

63. Apices of branches lacking clusters of microphyllous branchlets..64

64. Stems pinnate to tripinnately branched, sometimes frondose; stems and branches covered with paraphyllia (white, green, yellow or brown in colour with a hairy, granular or cobwebby appearance)...........................65
64. Stems irregularly branched or rarely pinnately branched but never frondose; paraphyllia lacking or not evident (rhizoids sometimes present which somewhat resemble paraphyllia but they occur only on the main stem)..66

65. Stems 1-pinnate, with a cobwebby apearance caused by a dense covering of long paraphyllia; plants of wet habitats, especially swampy cedar woods.........................Helodium blandowii

Helodium blandowii (Web. & Mohr) Warnst. **Fig. 88: 4-6**
In calcareous swamps, fens and pools in woods. NF to MB--GR to AK, south to NY, OH, MI, WI, MN, CO, AZ and WA.

65. Stems 1-3 pinnate, with a hairy or granular appearance due to short paraphyllia; plants often in dry habitats.......................Thuidium

THUIDIUM
(Fern Moss)

A. Plants 1-pinnate...T. abietinum

Thuidium abietinum (Hedw.) B.S.G. **Fig. 89: 1-4**
On dry, exposed, calcareous rocks and cliff shelves, on humus on slopes, and on rotten stumps. NF, NB, NS, QU, ON, MB--GR to AK, south to VA, IN, IA, SD, CO and AZ.

A. Plants 2- or 3-pinnate...B

B. Stem leaves arched and standing out from stem when dry; usually on calcareous substrata.............*T. recognitum*

Thuidium recognitum (Hedw.) Lindb. **Fig. 89: 5-7**

On calcareous soil, humus, boulders and sometimes on bases of trees in woods. NF to MB--LB to AK, south to GA, TN, AR, OK, MT and BC.

B. Stem leaves appressed or slightly spreading from stem when dry; usually on acidic substrata..*T. delicatulum*

Thuidium delicatulum (Hedw.) B.S.G. **Fig. 90: 1-3**

Usually in wet habitats on acidic substrata, such as humus, soil, boulders, rotten logs and stumps in woods. NF to MB--LB to AK, south to FL, AL, LA and TX; also in AZ.

66. Margins of stem and branch leaves ciliate..........................*Thelia hirtella*

Thelia hirtella (Hedw.) Sull. **Fig. 90: 4-6**

On bases of deciduous trees. NB, NS, QU, ON--Southern NS to southern ON, south to FL, MS, LA and TX.

66. Margins of stem and branch leaves not ciliate................................67

67. Stems much branched, covered with a mat of brown rhizoids that are lacking on branches; plants of calcareous swamps and fens....................................*Tomenthypnum nitens*

Tomenthypnum nitens (Hedw.) Loeske **Fig. 91: 1-4**

In calcareous swamps and fens. NF, NB, NS, QU, ON, MB--GR to AK, south to NJ, PA, MI, WI, MN, CO and WA.

67. Stems irregularly branched or if subpinnately branched, with few or no rhizoids; plants of various habitats...68

68. Leaves squarrose...*Campylium chrysophyllum*

Campylium chrysophyllum (Brid.) J. Lange **Fig. 91: 5-8**

On calcareous or noncalcareous rocks and soil, rotten wood and bases of trees. NF to MB--LB to YT, south to FL, LA, TX and AZ.

68. Leaves not squarrose..69

69. Stem leaves with an obtuse apex, often broad and entire............................70

69. Stem leaves with an acute apex..71

70. Plants of wet habitats (bogs, swamps, fens, etc.).......................*Calliergon*

CALLIERGON

A. Leaves appressed throughout the stems; costae reaching 3/4 the length of the leaves..*C. stramineum*

Calliergon stramineum (Brid.) Kindb. **Fig. 93: 1-3**

In bogs, fens, at margins of lakes and in shallow pools. NF to MB--GR to AK, south to NY, MI, WI, CO, MT and OR.

A. Leaves spreading or often appressed only at stem and branch apices; costae percurrent or ending just below apices.....................................B

B. Stems irregularly branched with few branches; stem leaves narrow, clearly longer than broad..C. cordifolium

Calliergon cordifolium (Hedw.) Kindb. **Fig. 93: 4-7**
In bogs, swamps, drainage ditches and wet depressions. NF to MB--GR to AK, south in the mountains and northern states to NC, TN, MI, IL, IA, CO, ID and WA.

B. Stems often pinnate with numerous branches; stem leaves broad, sometimes nearly as broad as long......................................C. giganteum

Calliergon giganteum (Schimp.) Kindb. **Fig. 94: 1-3**
In bogs, fens, swamps, shallow pools, ponds, and near springs. NF to MB--GR to AK, south to NY, PA, MI, WI, MN, CO, ID and WA.

70. Plants of dry habitats, always on limestone.......Anomodon viticulosus (See p. 100)

71. Leaves strongly falcate-secund, especially at stem and branch tips...72
71. Leaves not falcate-secund...74

72. Leaves short, seldom over 1 mm long...........Brachythecium velutinum (See p. 101)
72. Leaves long, mostly over 1 mm long...73

73. Leaves acute to short-acuminate, some narrowly obtuse, smooth; perichaetial leaves long and sheathing, nearly reaching capsule; on bases of trees, shrubs and rocks beside streams.............................Dichelyma pallescens

Dichelyma pallescens B.S.G. **Fig. 98: 1-3**
In periodically flooded places at margins of ponds and lakes on rocks and branches and bases of bushes and trees. NF, NB, NS, QU, ON--NF to ON, south to NY, MI, WI and MN.

73. Leaves long-acuminate; stem leaves sometimes plicate; perichaetial leaves short and not sheathing setae; often in swamps, fens and bogs or sometimes in woodlands on rock, wood or humus..................................Drepanocladus

DREPANOCLADUS
(Hooked Moss)

A. Stem and usually branch leaves plicate; plants green or yellowish green.................................D. uncinatus

Drepanocladus uncinatus (Hedw.) Warnst. **Fig. 98: 4-7**
In coniferous woods on bases of trees, humus, rotten logs, stumps and rocks or occasionally in wet meadows and drainage ditches. NF to MB--GR to AK, south to NY, PA, OH, MI, MN, NM, AZ and CA.

A. Stem and branch leaves smooth; plants often tinged with red or purple..B

B. Costae extending 3/4 or more the length of the leaves...*D. exannulatus*
Drepanocladus exannulatus (B.S.G.) Warnst. **Fig. 99: 1-4**
Often submerged in bogs, swamps, meadows, wet depressions and drainage ditches. NF to MB--GR to AK, south to NJ, NY, PA, MI, WI, CO, UT and CA.

B. Costae extending to middle of leaves, rarely beyond...*D. fluitans*
Drepanocladus fluitans (Hedw.) Warnst. **Fig. 99: 5-7**
In bogs, swamps, wet depressions and at margins of streams and lakes. NF to MB--GR to AK, south to VA, IN, MN, CO and CA.

74. Plants on rock, usually in streams..75
74. Plants on various substrata and if on rock, not in streams..78

75. Stems often with a wiry appearance, the basal part of the stem with only the remnants of costae attached; leaves narrow, less than 1 mm wide...76
75. Stems without wiry appearance, the entire leaves intact; leaves broad, often 1 mm wide..77

76. Leaves with a differentiated marginal border of a different colour and thickness than the rest of the leaf..*Sciaromium lescurii*
Sciaromium lescurii (Sull.) Broth. **Fig. 100: 1-4**
On rocks and boulders in waterfalls, creeks and rivers. NF, NS, ON, QU--NF to ON, south to GA, AL and AR.

76. Leaves without differentiated marginal border..............*Hygroamblystegium tenax*
Hygroamblystegium tenax (Hedw.) Jenn. **Fig. 100: 5-8**
On calcareous and noncalcareous boulders, rock ledges and bluffs or rarely woody debris in creeks and rivers. NF to MB--NF to BC, south to FL, AL, LA, TX, NM, AZ and CA.

77. Leaves decurrent....................................*Brachythecium rivulare* (See p. 101)
77. Leaves nondecurrent..*Hygrohypnum ochraceum*
Hygrohypnum ochraceum (Turn. *ex* Wils.) Loeske **Fig. 101: 1-4**
On soil over acidic rocks in and beside creeks, streams and waterfalls, sometimes beside lakes. NF to ON--GR to ON and MN, south in the mountains to NC and TN; in the West from AK to NT, south to CA, MT and CO.

78. Leaves long in relation to width, 7-15 times as long as wide; plants usually in aquatic habitats, such as swamps, creeks and rivers...................*Leptodictyum riparium*
Leptodictyum riparium (Hedw.) Warnst. **Fig. 101: 5-8**
On rocks and boulders (sometimes calcareous) in and beside creeks and rivers; also on fallen branches and woody debris in swamps and stagnant pools. NF to MB--LB to YT, south to FL, LA, TX, NM, AZ and CA.

78. Leaves short in relation to width, mostly less than 7 times as long as wide; plants mostly of dry or mesic habitats....................79

79. Leaves dull when dry, costa bulging on dorsal leaf surface and of a different colour than lamina....................80
79. Leaves glossy when dry, costa similar in colour to lamina....................82

80. Leaves acute to nearly obtuse....................Leskea polycarpa

Leskea polycarpa Hedw. **Fig. 102: 1-4**
On bases of trees or decaying logs, often in periodically flooded places. NB, NS, QU, ON, MB--NS to MB, south to NC, AL, MS, LA and NE; also in BC.

80. Leaves ending in an apiculus or a long, hyaline hair point....................81

81. Leaves (at least many) with a long, hyaline, often toothed apex....................Rhacomitrium (See p. 93)
81. Leaves apiculate or with a long, smooth hair point....................Anomodon

ANOMODON

A. Leaves with a long-filiform, hyaline acumen; leaf margins revolute....................A. rostratus

Anomodon rostratus (Hedw.) Schimp. **Fig. 94: 4-6**
On rocks and in cliff crevices that are frequently calcareous, on bases of trees and sometimes on soil and humus. NF, NB, NS, QU, ON, MB--NF to SA, south to FL, LA, TX, NM and AZ.

A. Leaves apiculate, acute or obtuse; leaf margins plane....................B

B. Plants with attenuate branches (especially noticeable when dry); branch leaves gradually narrowed to an acute apex, scarcely contorted when dry; occurring on tree trunks and calcareous and noncalcareous rock....................A. attenuatus

Anomodon attenuatus (Hedw.) Hüb. **Fig. 95: 1-5**
On tree trunks, bases of trees, rotten stumps and calcareous and noncalcareous rocks and cliff shelves. NF to MB--NF to MB, south to FL, LA, TX, NM and AZ.

B. Plants without attenuate branches; branch leaves obtuse or apiculate, strongly contorted when dry; occuring on calcareous rock....................A. viticulosus

Anomodon viticulosus (Hedw.) Hook. & Tayl. **Fig. 95: 6-8**
On calcareous rocks and cliff ledges, rarely on tree trunks. NB, NS, ON, QU--NS to ON, south NY, TN and AR.

82. Branch leaves broad at apex, acute to narrowly obtuse, strongly serrate, not twisted....................Eurhynchium pulchellum

Eurhynchium pulchellum (Hedw.) Jenn. **Fig. 102: 5-9**
On soil, rotten stumps and logs, bases of trees, rock outcrops and on humus over rock. NF to MB--GR to AK, south to GA, LA, TX, NM, AZ and CA.

82. Branch leaves narrow at apex, acute to acuminate, sometimes twisted...83

83. Stem leaves smooth, nearly as broad as long, apex often abruptly narrowed, acute and twisted........................Bryhnia novae-angliae
Bryhnia novae-angliae (Sull. & Lesq. ex Sull.) Grout **Fig. 103: 1-5**
On soil, rocks, humus and rotten logs in wet shady places, especially along creeks. NF to ON--NF to ON and WI, south in the mountains to NC, TN and GA; also in MO, AR and CA.

83. Stem leaves often plicate, usually longer than broad, apex usually gradually narrowed, acuminate, straight or sometimes twisted..Brachythecium

BRACHYTHECIUM

A. Plants small, leaves seldom reaching 1.5 mm long; setae rough...B
A. Plants large, leaves usually over 1.5 mm long and reaching 3 mm; setae rough or smooth.............................C

B. Leaves falcate-secund; stem leaves short-decurrent, margins plane or recurved at base.................B. velutinum
Brachythecium velutinum (Hedw.) B.S.G. **Fig. 97: 5-8**
Mainly in rather dry habitats on soil, often over rock, and on bases of trees. NF to MB--LB to BC, south to NY, MI, MN, WY, UT and CA.

B. Leaves straight or nearly so; stem leaves long-decurrent, margins recurved to leaf middle or above......................................B. reflexum
Brachythecium reflexum (Starke ex Web. & Mohr) B.S.G. **Fig. 97: 1-4**
Usually in dry woods, on bases of trees, rotten logs and stumps and humus over rocks. NF to MB--GR to AK, south to VA, MI, WI, MN and OR.

C. Leaves smooth or plicate, stem leaves long-decurrent; setae rough; occurring in wet habitats in and beside creeks, rivers, springs, etc.......................B. rivulare
Brachythecium rivulare B.S.G. **Fig. 96: 1-3**
On soil, rocks and logs in and beside creeks, rivers, springs and seepy places. NF to MB--LB to AK, south to NC, AR, NM, AZ, NV and WA.

C. Leaves plicate, stem leaves short-decurrent; setae smooth; occurring in dry to mesic habitats...............B. salebrosum
Brachythecium salebrosum (Web. & Mohr) B.S.G. **Fig. 96: 4-6**
Usually in dry, disturbed habitats on rock, soil, humus, rotten stumps and logs and bases of trees. NF to MB--GR to AK, south to NC, TN, LA, TX, CO, AZ and CA.

84. Plants aquatic, in flowing water of streams; stems long, often 10 cm or more in length .... Fontinalis

FONTINALIS
(Water Moss)

A. Leaves keeled; plants often yellowish to brownish green .... F. antipyretica

Fontinalis antipyretica Hedw. **Fig. 103: 6-8**
On boulders and twigs in creeks and ponds. NF, NB, NS, QU, ON, MB--GR to AK, south to PA, MI, WI, MN, NM, AZ and CA.

A. Leaves concave; plants usually green to brownish .... B

B. Leaves broad, 2-3 times as long as wide, the margins plane when dry .... F. novae-angliae

Fontinalis novae-angliae Sull. **Fig. 104: 1-3**
On rocks in flowing water in creeks and rivers or at margins of lakes. NF, NB, NS, QU, ON, MB--NF to MB, south to FL, LA and OK.

B. Leaves narrow, 3-5 times as long as wide, the margins sometimes reflexed when dry .... F. dalecarlica

Fontinalis dalecarlica Schimp. ex B.S.G. **Fig. 104: 4-8**
On rocks, branches and logs in running water of creeks and rivers. NF, NB, NS, QU, ON, MB--GR to AT, south to FL, TN, WI and MN.

84. Plants not aquatic 85

85. Leaves with whitish tips, those surrounding immersed capsules with cilia on margins; eperistomate; on noncalcareous rock .... Hedwigia ciliata

Hedwigia ciliata (Hedw.) P. Beauv. **Fig. 105: 1-4**
On dry, exposed, usually acidic boulders and cliffs. NF, NB, NS, QU, ON, MB--GR to AK, south throughout most of the United States.

85. Leaves lacking whitish tips and cilia; peristomate; on various substrates 86

86. Stems and branches with clusters of microphyllous branchlets in leaf axils 87

86. Stems and branches lacking clusters of microphyllous branchlets in leaf axils 89

87. Leaves distant, wide-spreading, stems and branches often visible between leaves; on soil or rock .... Isopterygium elegans

Isopterygium elegans (Brid.) Lindb. **Fig. 105: 5-8**
On soil and humus on banks and cliffs in moist woodlands. NF to ON--LB to ON, south to SC, GA, TN and AR; in the West from AK to BC, south to CA.

87. Leaves close, erect, stems and branches not visible between leaves 88

88. Leaves smooth, branches straight when dry;
often with sporophytes...*Platygyrium repens*

Platygyrium repens (Brid.) B.S.G. **Fig. 106: 1-5**
On tree trunks, rotten logs and stumps. NF to MB--NF to MB, south to FL, AL, LA and OK; also in BC, AT and SA.

88. Leaves plicate, branches curved when dry;
never with sporophytes........................*Leucodon brachypus* var. *andrewsianus*

Leucodon brachypus var. **andrewsianus** Crum & Anders. **Fig. 106: 6-9**
On tree trunks, rotten logs or sometimes on rock. NF to ON--NF to ON, south to NC, TN and MI.

89. Stems and branches covered with long, branched, white, yellow, or green paraphyllia giving them a cobwebby
appearance; stems often frondose, 1-3 pinnate...............................*Hylocomium*

HYLOCOMIUM

A. Stems regularly branched, 2-3 pinnate; stem leaves usually with a long, slender,
undulate acumen...*H. splendens*

Hylocomium splendens (Hedw.) B.S.G. **Fig. 107: 1-5**
(Stair-Step Moss)
On humus, rotten logs, soil and rocks in swamps and forests. NF to MB--GR to AK, south to NC, GA, TN, MI, IA, SD, CO, ID and CA.

A. Stems irregularly branched, 1-2 pinnate; stem
leaves broadly acuminate and not undulate........................*H. umbratum*

Hylocomium umbratum (Hedw.) B.S.G. **Fig. 107: 6-10**
On rotten wood and humus over rocks in forests. NF to ON--LB to ON, south in the mountains and northern states to NC, TN and MI; also in AK and BC.

89. Stems and branches lacking paraphyllia...90

90. Plants julaceous...91
90. Plants not julaceous...97

91. Plants pinnately branched..92
91. Plants irregularly branched..94

92. Plants small, stem leaves acuminate, seldom
up to 1 mm long...*Heterocladium dimorphum*

Heterocladium dimorphum (Brid.) B.S.G. **Fig. 108: 1-5**
On soil and humus banks, bases of trees and boulders in moist woods. NF to ON--LB to ON, south to NY and MI; in the West from AT to YT, south to MT and OR.

92. Plants robust, stem leaves apiculate, often
1 mm long or more..93

93. Stems and branches orange or red.................................*Pleurozium schreberi*

Pleurozium schreberi (Brid.) Mitt. **Fig. 108: 6-10**
(Red-Stemmed Feather Moss)
On humus and soil in woods, occasionally in bogs,

sometimes occurring on stumps. NF to MB--GR to AK, south to NC, TN, AR, SD, CO, ID and OR.

93. Stems and branches yellow or green............................*Calliergonella cuspidata*

Calliergonella cuspidata (Hedw.) Loeske **Fig. 109: 1-5**
A calciphile occurring in swamps, fens and alkaline bogs. NF to ON--NF to AK, south to NC, TN, MI, MN, WY, ID and CA.

94. Plants large, stem leaves often 1 mm long....................................95
94. Plants small, stem leaves less than 1 mm long.................................96

95. Leaves often short to long-acuminate, contorted when dry, stems often visible between leaves; on soil or humus over rock, sometimes over bases of trees and rotten wood..*Plagiothecium*

PLAGIOTHECIUM

A. Plants julaceous to complanate, leaves concave, symmetric, the apices often recurved; capsules erect, often striate when dry..................................*P. cavifolium*

Plagiothecium cavifolium (Brid.) Iwats. **Fig. 109: 6-9**
On soil over cliff ledges, on stumps, rotten wood, bases of trees, clay banks and humus in woods. NF to ON--GR to ON, south to GA, TN and AR; in the West from AK to WA; also in YT, CO and ID.

A. Plants complanate, leaves flat, asymmetric, the apices not recurved; capsules erect or inclined, smooth or striate when dry......................................B

B. Leaf margins recurved; capsules inclined, striate when dry..*P. denticulatum*

Plagiothecium denticulatum (Hedw.) B.S.G. **Fig. 110: 1-4**
In wet woods on rotten logs, soil, humus and rarely on rocks. NF to MB--GR to AK, south to NC, TN, AR, NM and CA.

B. Leaf margins plane; capsules erect, rarely inclined, smooth..*P. laetum*

Plagiothecium laetum B.S.G. **Fig. 110: 5-8**
On rotten logs, stumps, bases of trees, humus and soil on steep banks and over boulders and cliffs in woods. NF to MB--GR to AK, south to NC, TN, IA, NM and CA.

95. Leaves acute to apiculate, scarcely contorted when dry, stems not visible between leaves; on bases of trees and rotten wood, rarely on rock.................................*Entodon seductrix*

Entodon seductrix (Hedw.) C. Müll. **Fig. 111: 1-4**
On rotten wood, bases of trees, rocks and soil in deciduous woods. QU, ON--QU to ON and MN, south to Fl, LA and TX.

96. Leaves about as broad as long, often ending in a short, hair-like apiculus, margins sometimes spinose; on calcareous rock...*Myurella*

MYURELLA

A. Plants julaceous, leaves close, imbricate, apiculate or sometimes obtuse, margins entire or nearly so..................M. julacea

Myurella julacea (Schwaegr.) B.S.G. **Fig. 112: 1-4**
In crevices and on soil over ledges of cliffs (usually calcareous), sometimes on rotten logs and stumps and on soil or humus at bases of trees. NF, NB, NS, QU, ON, MB--GR to AK, south to CT, NY, MI, WI, MN, CO and OR.

A. Plants not or rarely somewhat julaceous, leaves distant, spreading, acuminate, margins often spinulose..................M. sibirica

Myurella sibirica (C. Müll.) Reim. **Fig. 112: 5-7**
In crevices and on soil over ledges of calcareous cliffs. NF, NB, NS, QU, ON--NF to ON, south to NC, IN and AR; also in AK, YT and NT.

96. Leaves longer than broad, acute to obtuse, margins entire; on wood or noncalcareous rock..................Pterigynandrum filiforme

Pterigynandrum filiforme Hedw. **Fig. 113: 1-3**
On acidic boulders and cliffs in woods or occasionally on logs and tree trunks. NF to ON--GR to AK, south in the mountains and northern states to NC, TN, MI, WI, MN, SD, CO, ID and CA.

97. Plants complanate..................98
97. Plants not complanate..................103

98. Leaves strongly undulate; setae short, capsules immersed; occurring on tree trunks..................Neckera pennata

Neckera pennata Hedw. **Fig. 113: 4-7**
On tree trunks or occasionally on rock, rarely on rotten logs. NF to MB--GR to AK and BC, south in the mountains and northern states to NC, TN, MI, WI, MN, NM and AZ.

98. Leaves not undulate; setae long, capsules exserted; occurring on various substrata..................99

99. Leaf apices broad and rounded..................Homalia trichomanoides (See p. 95)
99. Leaf apices narrow and acute..................100

100. Stems and branches orange or red..................Pylaisiadelpha recurvans

Pylaisiadelpha recurvans (Michx.) Buck **Fig. 114: 1-4**
On rotten logs, bases of trees, humus and rock. NF to MB--NF to MB, south to FL, AL, IL and IA.

100. Stems and branches yellow or green..................101

101. Leaves asymmetric..................Plagiothecium (See p. 104)
101. Leaves symmetric..................102

102. Leaves acuminate; occurring on soil over calcareous rock, sometimes on bases of trees or rotten wood..................Taxiphyllum deplanatum

Taxiphyllum deplanatum (Bruch & Schimp. ex Sull.) Fleisch. **Fig. 114: 5-8**
Usually on wet, calcareous rock bluffs, sometimes on bases of deciduous trees and rotten wood. NB, QU, ON, MB--NB to SA, south to NC, TN and AR; also in AL, LA, NM and AZ.

102. Leaves acute or rarely acuminate; on rotten wood and bases of trees, occasionally occurring on soil or rock...Entodon cladorrhizans

Entodon cladorrhizans (Hedw.) C. Müll. **Fig. 111: 5-8**
On rotten wood, bases of trees, rocks and soil in deciduous woods. QU, ON--QU to ON and MN, south to GA, AR and OK.

103. Leaves plicate to striolate...104
103. Leaves smooth, not plicate or striolate...106

104. Plants irregularly branched, leaves striolate when dry...Campylium stellatum

Campylium stellatum (Hedw.) C. Jens. **Fig. 92: 1-4**
A calciphile in fens, meadows, bogs, at margins of lakes, rarely on wet rocks. NF, NB, NS, QU, ON, MB--GR to AK, south to GA, IN, IA, NM and OR.

104. Plants pinnately branched, leaves plicate....................................105

105. Plants plumose, stems and branches yellow or green, leaves falcate-secund, long-acuminate........................Ptilium crista-castrensis

Ptilium crista-castrensis (Hedw.) De Not. **Fig. 115: 1-5**
(Plume Moss)
On soil, humus, boulders, cliffs and rotten logs in moist coniferous woods. NF to MB--LB to AK, south to NC, TN, MI, IA, MT, ID and OR.

105. Plants sparsely pinnate, stems and branches orange or red, leaves erect or some squarrose................................Rhytidiadelphus

RHYTIDIADELPHUS

A. Stem leaves smooth, strongly squarrose to squarrose-recurved..R. subpinnatus

Rhytidiadelphus subpinnatus (Lindb.) Kop. **Fig. 115: 6-10**
On humus, soil, rotten logs and wet boulders in woods, swamps and wet meadows, or sometimes on sandy soil beside rivers and lakes. NF to ON--LB to ON, south to MA and TN; in the West from AK to AT, south to OR and ID.

A. Stem leaves plicate, not or weakly squarrose..............................B

B. Leaves rugose near apex, noticeably crowded near stem apices; costae strong, extending to middle of leaves or above.......................R. triquetrus

Rhytidiadelphus triquetrus (Hedw.) Warnst. **Fig. 116: 1-5**
(Rough Neck Moss)
On humus, soil and rotten logs in dry to moist woods, sometimes in swamps and on calcareous boulders and cliff ledges. NF to MB--LB to AK, south to NC, TN, AR, MB, MT, ID and CA.

B. Leaves neither rugose nor noticeably crowded at stem apices; costae lacking or weak and ending below middle of leaves..........................R. loreus

Rhytidiadelphus loreus (Hedw.) Warnst. **Fig. 116: 6-10**
On logs, humus and rocks in coniferous woods. NF, NS--LB and NF, south to NS and ME; in the West from AK to CA; also in ID and MT.

106. Leaves squarrose..107
106. Leaves not squarrose..110

107. Plants subpinnately branched, stems and branches orange or red..............................Rhytidiadelphus subpinnatus (See p. 106)
107. Plants irregularly branched, stems and branches yellow or green..108

108. Leaves large, often 2 mm or more in length, strongly twisted when dry; plants of wet habitats, such as fens and swamps..........................Campylium stellatum (See p. 106)
108. Leaves small, mostly less than 2 mm long, straight or somewhat contorted when dry; plants of mesic to dry habitats..109

109. Leaves mostly less than 1 mm long, ovate to cordate; capsules smooth..Campylium hispidulum

Campylium hispidulum (Brid.) Mitt. **Fig. 92: 5-8**
On soil, rocks, bases of trees and rotten logs. NF, NB, NS, QU, ON, MB--LB to AK, south to FL, AL, MS and TX.

109. Leaves usually 1 mm long or more, oblong-lanceolate to ovate; capsules striate..Herzogiella

HERZOGIELLA

A. Leaves close, squarrose to squarrose-recurved..H. striatella

Herzogiella striatella (Brid.) Iwats. **Fig. 117: 1-4**
On humus, acidic rocks, soil over rocks, clay banks, rotten logs and bases of trees. NF to ON--LB to ON, south to GA, TN, WI and MO; in the West from AK, BC, WA and AT.

A. Leaves distant, erect-spreading to wide-spreading..H. turfacea

Herzogiella turfacea (Lindb.) Iwats. **Fig. 117: 5-8**
On rotten logs, stumps, bases of trees, humus over boulders, and soil in moist, coniferous woods. NF to MB--LB to MB, south to NC, TN, MI, IL and MN; also in SA, AT, MT and SD.

110. Leaves falcate-secund, the apices turned toward the substrate..Hypnum

HYPNUM

A. Stems pinnately branched; sporophytes often present...B

A. Stems irregularly branched; sporophytes rare..............................C

B. Plants large, stems and branches often 1 mm wide of more, stems usually reddish.....................H. imponens

Hypnum imponens Hedw. **Fig. 118: 1-5**
Frequently on rotten logs and stumps in woods, sometimes on humus, soil and soil over boulders. NF to ON--LB to ON, south to GA, AL and AR.

B. Plants small, stems and branches mostly less than 1 mm wide, stems green............................H. pallescens

Hypnum pallescens (Hedw.) P. Beauv. **Fig. 118: 6-10**
On bases of deciduous and coniferous trees, decaying wood, especially logs and stumps, and boulders in woods. NF to MB--NF to BC, south in the mountains and northern states to GA, TN, MI, WI, MN and MT; also in LA and AZ.

C. Leaves close and imbricate, concave, the stems and branches somewhat julaceous.......................H. cupressiforme

Hypnum cupressiforme Hedw. **Fig. 119: 1-5**
On calcareous boulders and cliffs, sometimes on bases of trees, mainly in dry, exposed places. NF to MB--LB to AK, south to NC, TN, AR, MN, NE, CO, AZ and WA.

C. Leaves more distant, complanate to weakly concave, stems and branches not julaceous.....................H. lindbergii

Hypnum lindbergii Mitt. **Fig. 119: 6-10**
On humus, rocks, and wet soil in roadside ditches, meadows, beside lakes and in swampy places. NF to MB--GR to AK, south to FL, AL, MS, LA, TX, NM, ID and WA.

110. Leaves straight or somewhat curved..111

111. Stems and branches somewhat flattened, leaves acute to short-acuminate, alar cells often coloured orange or brown; capsules inclined and curved; on rotten wood, sometimes on bases of trees, soil or rock...............Callicladium haldanianum

Callicladium haldanianum (Grev.) Crum **Fig. 120: 1-5**
Commonly on rotten logs and stumps but occasionally on bases of trees, rock and soil. NF to MB--NF to MB, south to NC, IN and LA; also in BC, AZ and CA.

111. Stems and branches not flattened, leaves long-acuminate, alar cells not coloured; capsules erect and straight; on tree trunks.............................Pylaisiella polyantha

Pylaisiella polyantha (Hedw.) Grout **Fig. 120: 6-9**
Usually on deciduous tree trunks, occasionally on rotten stumps and rocks. NF, NB, NS, QU, ON, MB--LB to AK, south to NC, MI, IA, NE, NM and AZ.

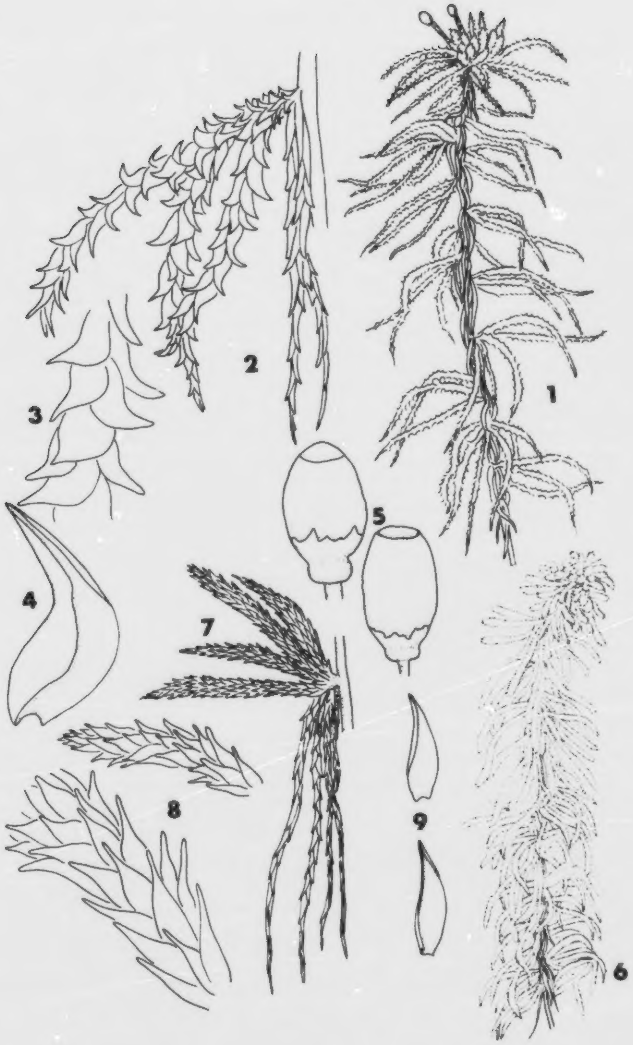

FIGURE 45. 1-5, **Sphagnum squarrosum**. 1. Habit (x1). 2. Fascicle of branches (x4). 3. Portion of branch (x9). 4. Branch leaf (x18). 5. Capsules, operculate and inoperculate (x4). 6-9, **Sphagnum wulfianum**. 6. Habit (x1). 7. Fascicle of branches (x4). 8. Portion of branch (x9, x18). 9. Branch leaves (x18).

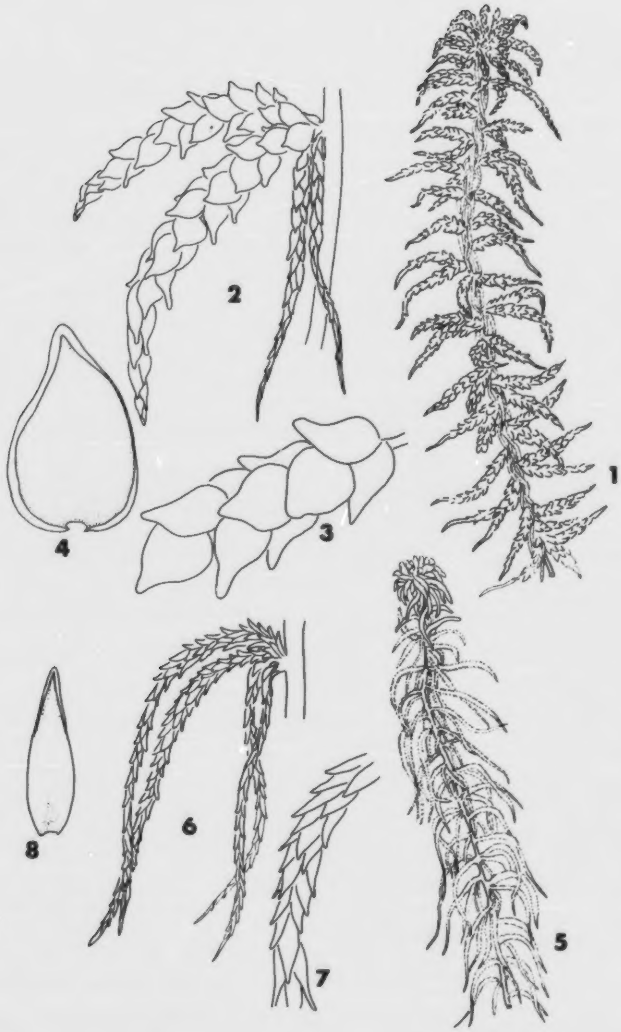

FIGURE 46. 1-4, **Sphagnum magellanicum.** 1. Habit (x1). 2. Fascicle of branches (x3). 3. Portion of branch (x9). 4. Branch leaf (x18). 5-8, **Sphagnum capillifolium.** 5. Habit (x1). 6. Fascicle of branches (x3). 7. Portion of branch (x9). 8. Branch leaf (x18).

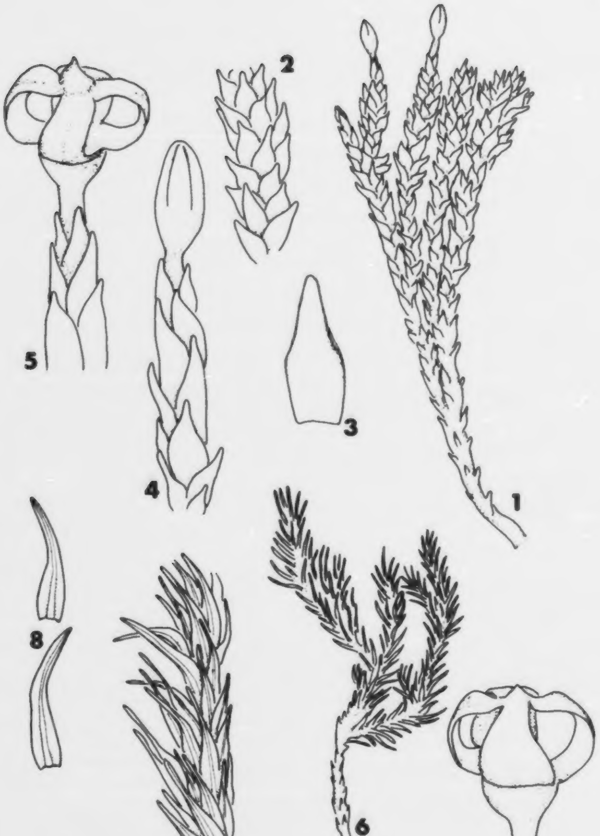

FIGURE 47. 1-5, **Andreaea rupestris.** 1. Habit (x9). 2. Portion of stem (x18). 3. Leaf (x36). 4. Capsule, wet (x36). 5. Capsule, dry (x36). 6-9, **Andreaea rothii.** 6. Habit (x9). 7. Portion of stem (x18). 8. Leaves (x36). 9. Capsule, dry (x36).

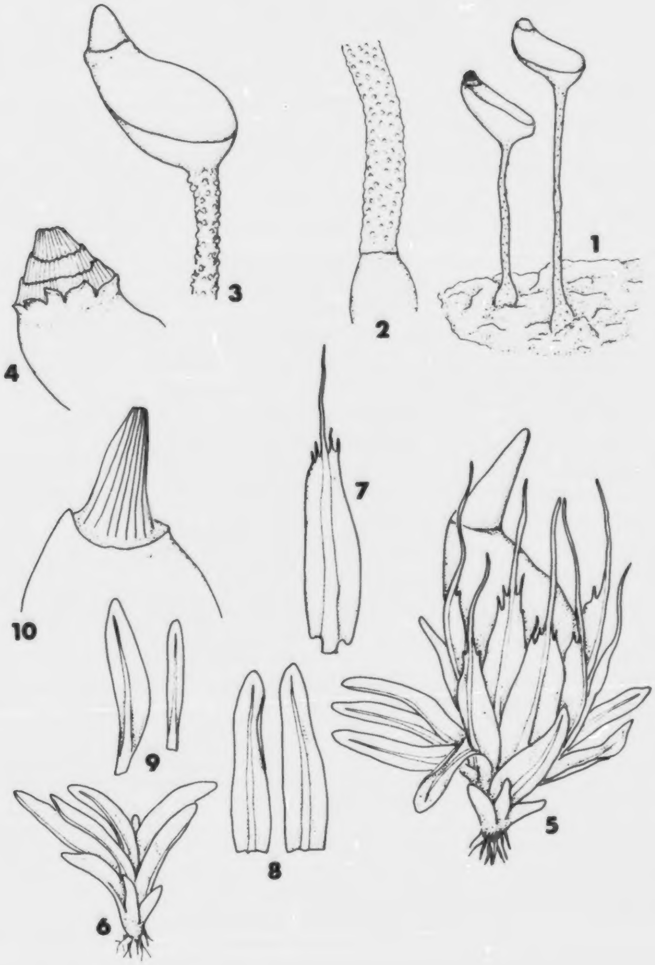

FIGURE 48. 1-4, **Buxbaumia aphylla.** 1. Habit (x4). 2. Basal portion of seta (x18). 3. Capsule (x9). 4. Peristome teeth and mouth of capsule (x36). 5-10, **Diphyscium foliosum.** 5. Habit of female plant with capsule (x18). 6. Habit of male plant (x18). 7. Perichaetial leaf (x18). 8. Lower leaves of female plant (x18). 9. Leaves of male plant (x18). 10. Peristome teeth and mouth of capsule (x36).

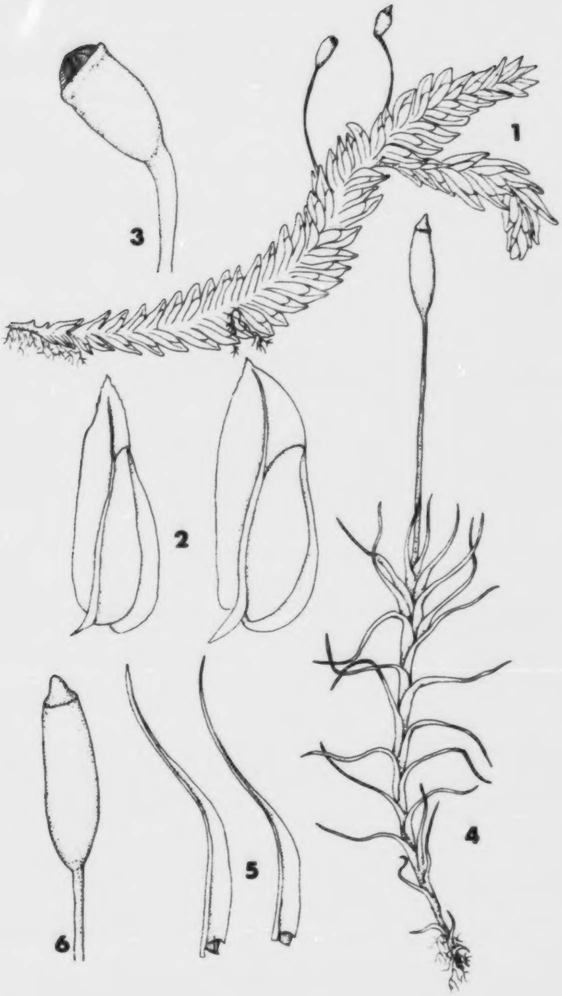

FIGURE 49. 1-3, **Fissidens adiantoides.** 1. Habit (x3). 2. Leaves (x18). 3. Capsule (x18). 4-6, **Distichium capillaceum.** 4. Habit (x9). 5. Leaves (x18). 6. Capsule (x18).

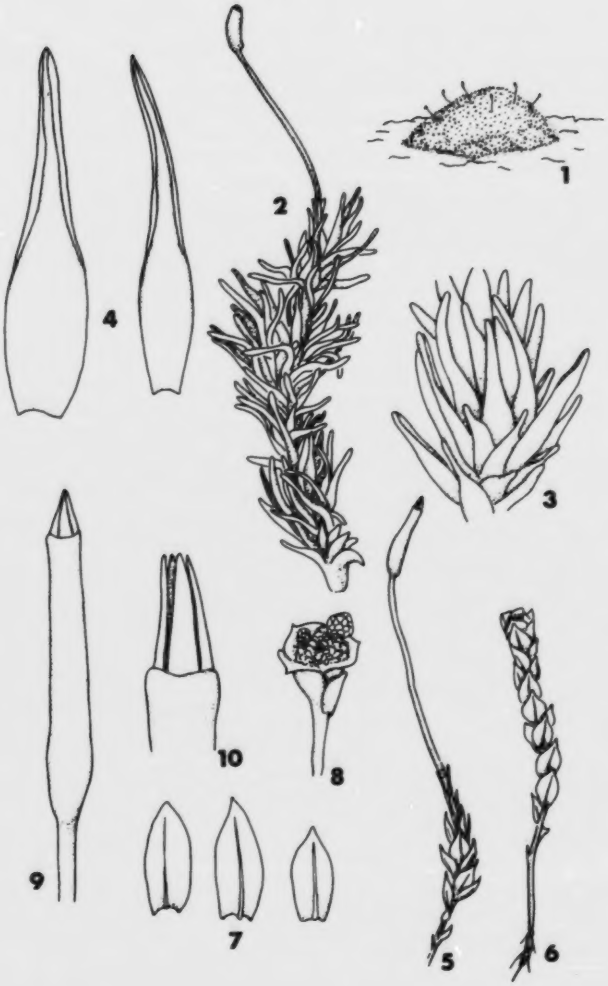

FIGURE 50. 1-4, **Leucobryum glaucum.** 1. Cushion of plants showing growth habit. 2. Habit (x4). 3. Portion of stem (x6). 4. Ventral view of leaves (x9). 5-10, **Tetraphis pellucida.** 5. Habit of fertile plant (x4). 6. Habit of gemmiferous plant (x4). 7. Lower leaves (x18). 8. Gemma cup (x9). 9. Capsule (x18). 10. Peristome teeth (x36).

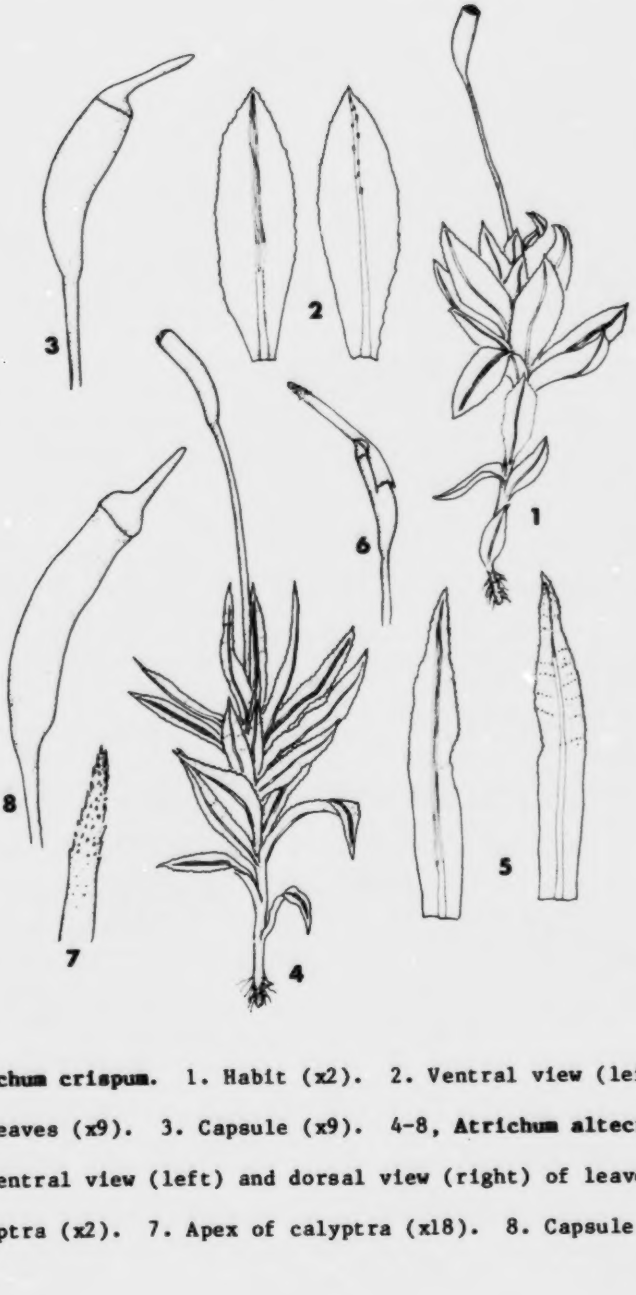

FIGURE 51. 1-3, **Atrichum crispum.** 1. Habit (x2). 2. Ventral view (left) and dorsal view (right) of leaves (x9). 3. Capsule (x9). 4-8, **Atrichum altecristatum.** 4. Habit (x3). 5. Ventral view (left) and dorsal view (right) of leaves (x9). 6. Capsule with calyptra (x2). 7. Apex of calyptra (x18). 8. Capsule (x9).

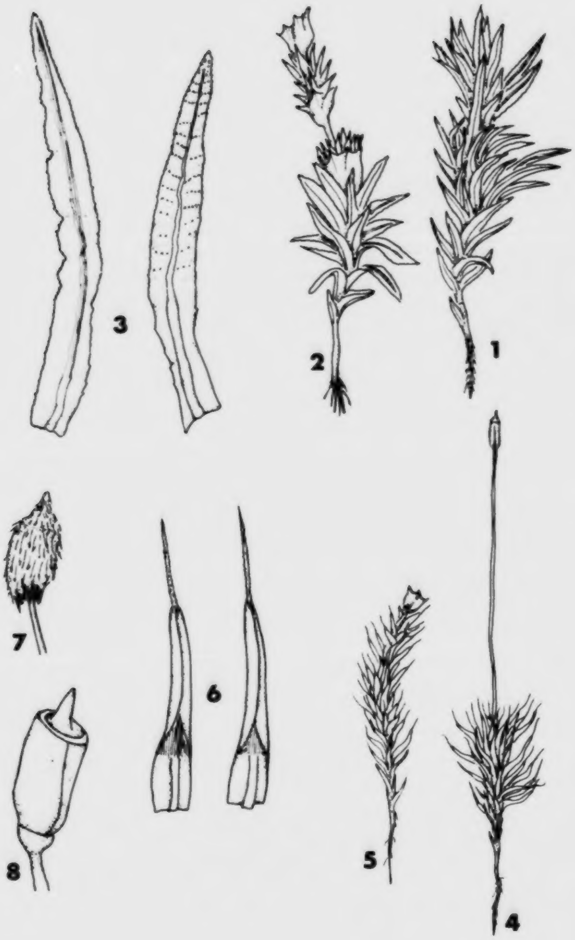

FIGURE 52. 1-3, **Atrichum oerstedianum.** 1. Habit of female plant (x2). 2. Habit of male plant (x2). 3. Ventral view (left) and dorsal view (right) of leaves (x9). 4-8, **Polytrichum piliferum.** 4. Habit of female plant with sporophyte (x1). 5. Habit of male plant (x1). 6. Ventral view of leaves (x9). 7. Calyptra on capsule (x4). 8. Capsule (x9).

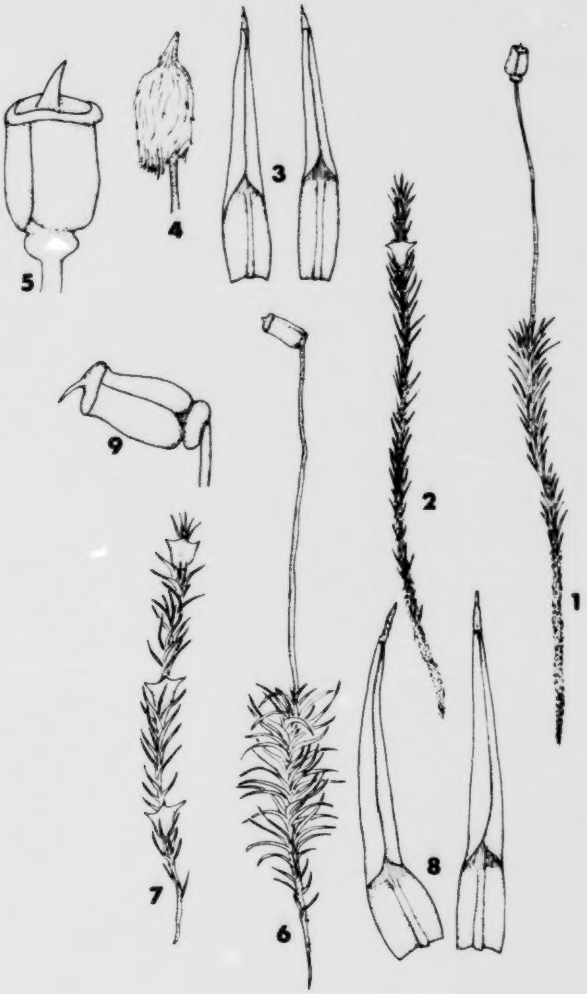

FIGURE 53. 1-5, **Polytrichum strictum**. 1. Habit of female plant with sporophyte (x1). 2. Habit of male plant (x1). 3. Ventral view of leaves (x9). 4. Calyptra on capsule (x4). 5. Capsule (x9). 6-9, **Polytrichum juniperinum**. 6. Habit of female plant with sporophyte (x1). 7. Habit of male plant (x1). 8. Ventral view of leaves (x9). 9. Capsule (x4).

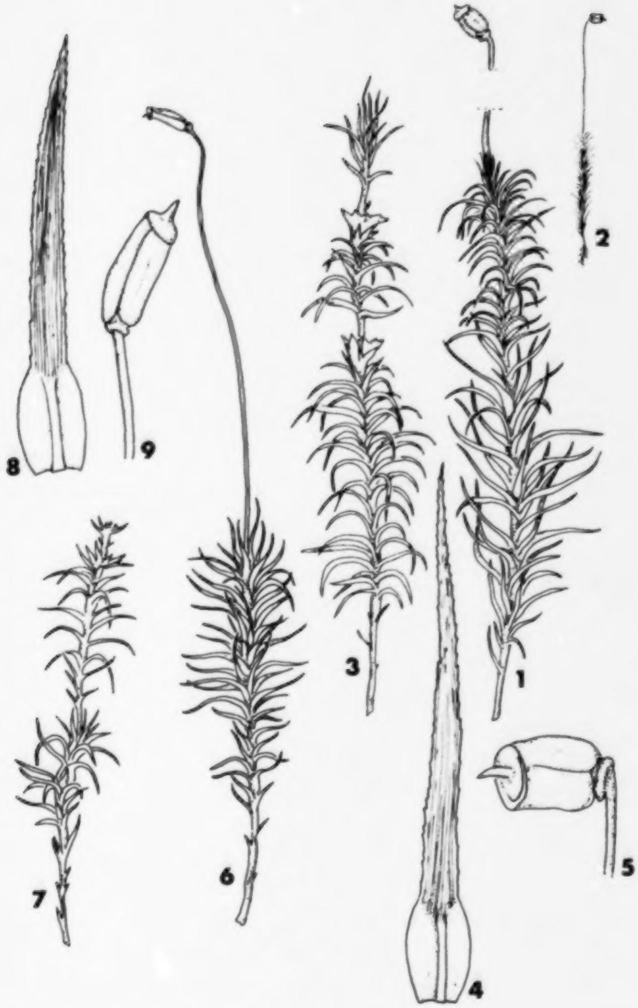

FIGURE 54. 1-5, **Polytrichum commune**. 1. Habit of female plant with shortened sporophyte (x1). 2. Habit of female plant with sporophyte (x1/5). 3. Habit of male plant (x1). 4. Ventral view of leaf (x9). 5. Capsule (x4). 6-9, **Polytrichum ohioense**. 6. Habit of female plant with sporophyte (x1). 7. Habit of male plant (x1). 8. Ventral view of leaf (x9). 9. Capsule (x4).

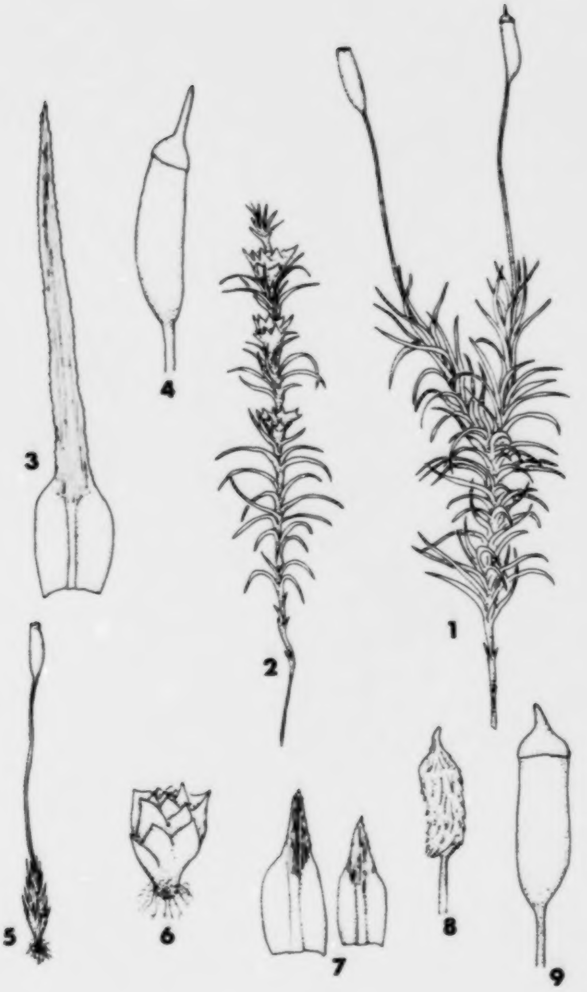

FIGURE 55. 1-4, **Pogonatum alpinum**. 1. Habit of female plant with sporophytes (x2). 2. Habit of male plant (x2). 3. Ventral view of leaf (x9). 4. Capsule (x4). 5-9, **Pogonatum pensilvanicum**. 5. Habit of female plant with sporophyte (x2). 6. Habit of male plant (x18). 7. Ventral view of leaves (x9). 8. Calyptra on capsule (x4). 9. Capsule (x9).

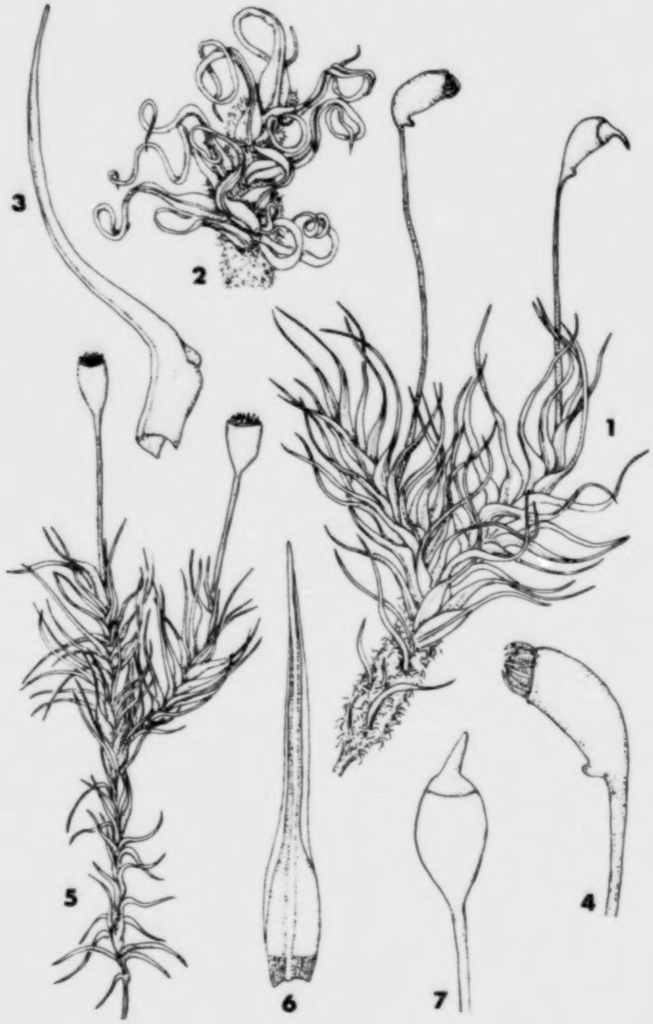

FIGURE 56. 1-4, **Oncophorus wahlenbergii.** 1. Habit (x9). 2. Portion of stem, dry (x18). 3. Leaf (x18). 4. Capsule (x18). 5-7, **Blindia acuta.** 5. Habit (x9). 6. Leaf (x36). 7. Capsule (x18).

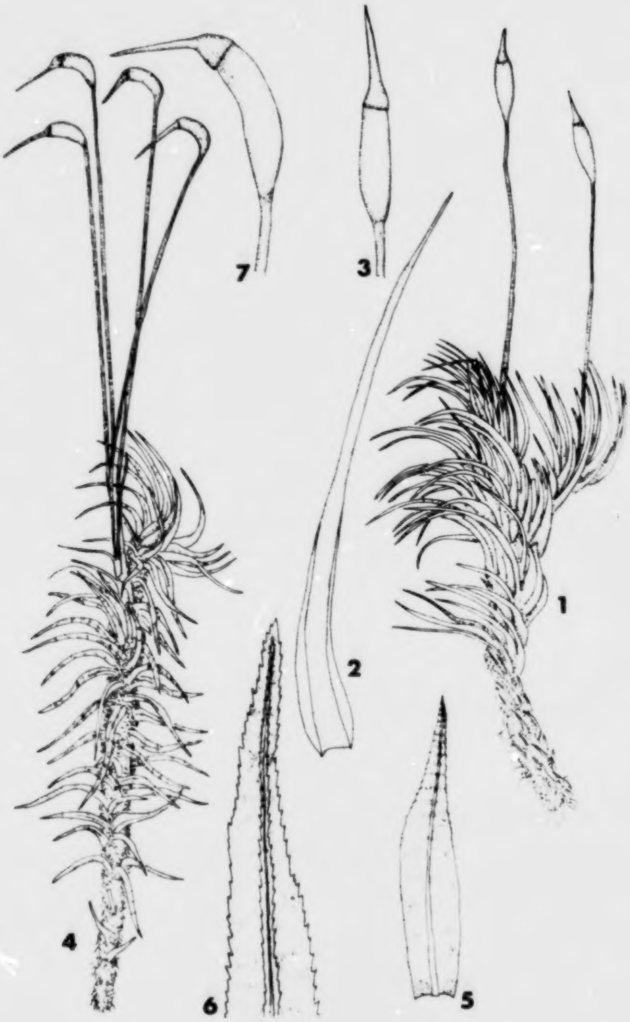

FIGURE 57. 1-3, **Paraleucobryum longifolium.** 1. Habit (x4). 2. Leaf (x18). 3. Capsule (x9). 4-7, **Dicranum polysetum.** 4. Habit (x2). 5. Leaf (x9). 6. Dorsal view of leaf apex (x36). 7. Capsule (x9).

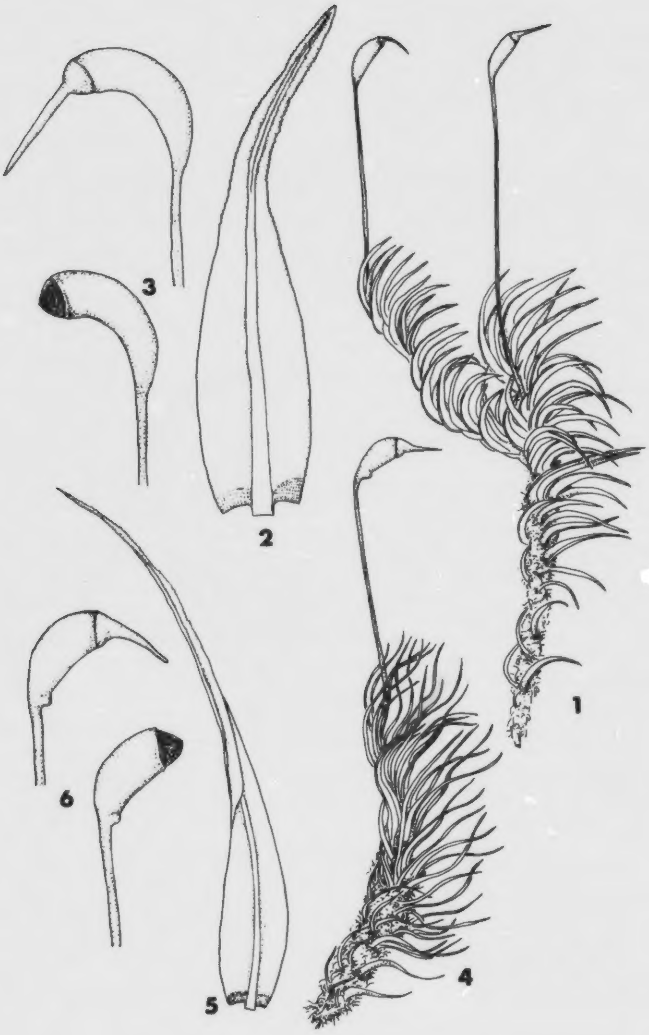

FIGURE 58. 1-3, **Dicranum scoparium**. 1. Habit (x2). 2. Dorsal view of leaf (x18). 3. Capsules, operculate and inoperculate (x9). 4-6, **Dicranum fuscescens**. 4. Habit (x4). 5. Leaf (x18). 6. Capsules, operculate and inoperculate (x9).

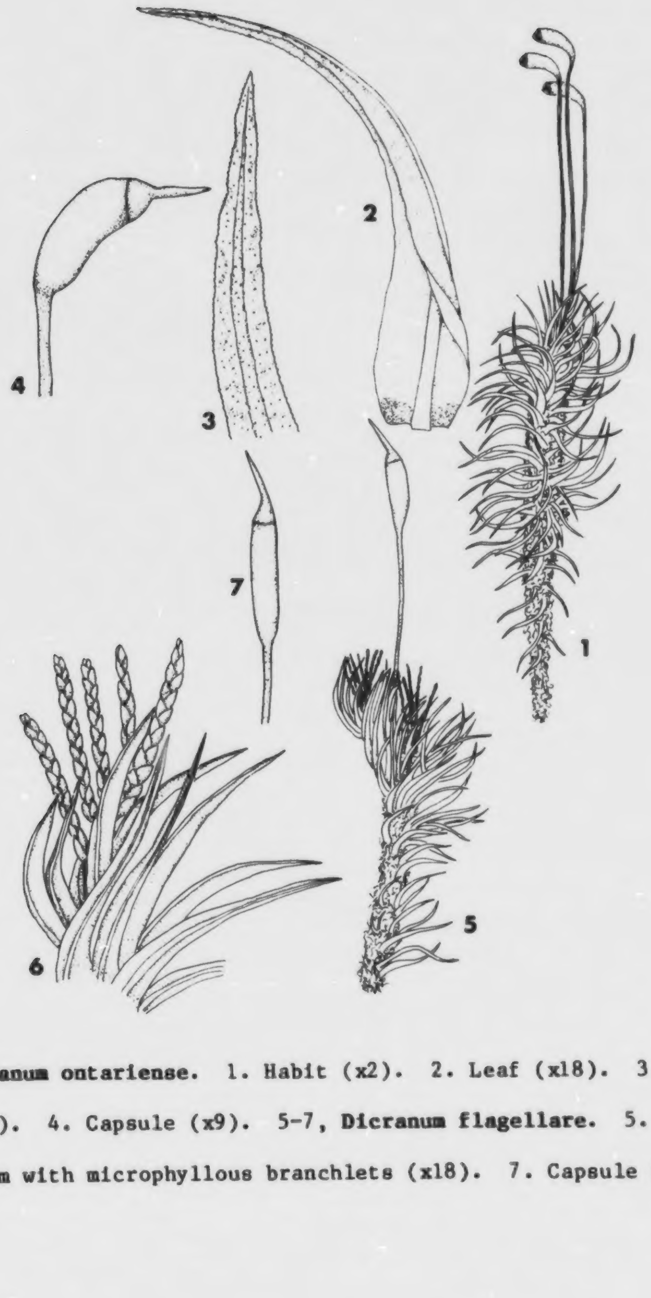

FIGURE 59. 1-4, **Dicranum ontariense.** 1. Habit (x2). 2. Leaf (x18). 3. Dorsal view of leaf apex (x36). 4. Capsule (x9). 5-7, **Dicranum flagellare.** 5. Habit (x4). 6. Portion of stem with microphyllous branchlets (x18). 7. Capsule (x9).

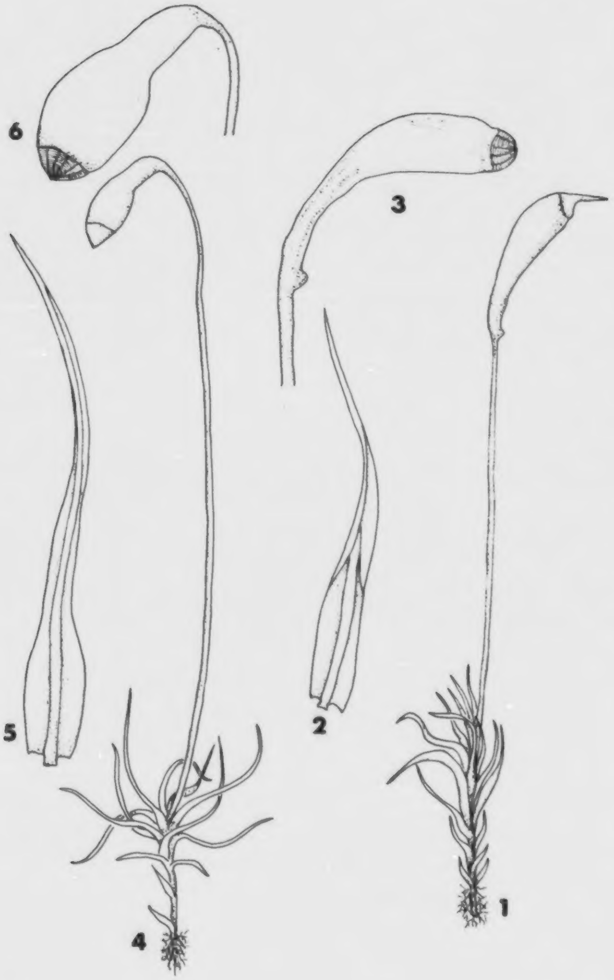

FIGURE 60. 1-3, **Trematodon ambiguus**. 1. Habit (x9). 2. Leaf (x36). 3. Capsule, dry (x18). 4-6, **Leptobryum pyriforme**. 4. Habit (x9). 5. Leaf (x36). 6. Capsule, wet (x18).

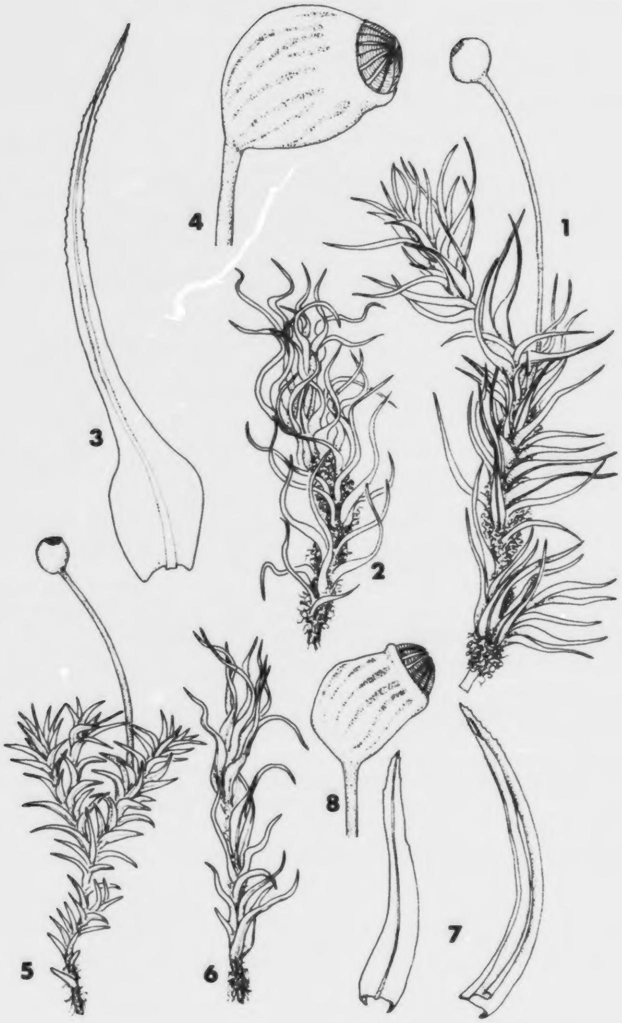

FIGURE 61. 1-4, **Bartramia pomiformis.** 1. Habit (x4). 2. Portion of stem, dry (x4). 3. Leaf (x18). 4. Capsule, dry (x18). 5-8, **Plagiopus oederiana.** 5. Habit (x4). 6. Portion of stem, dry (x9). 7. Leaves (x18). 8. Capsule, dry (x18).

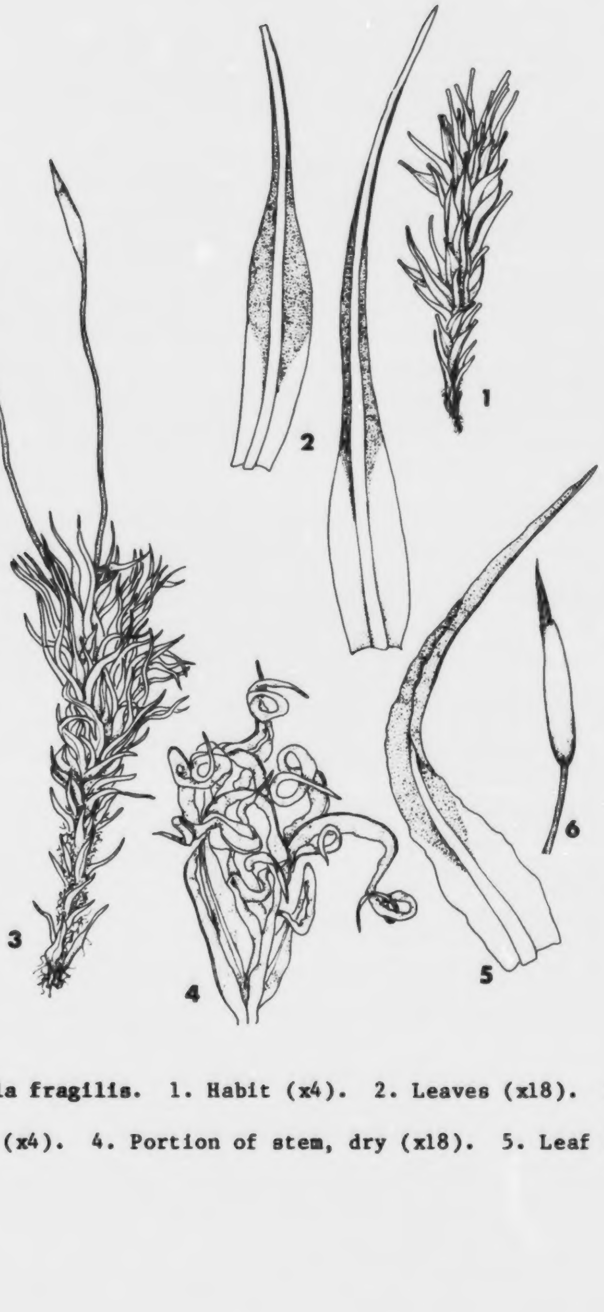

FIGURE 62. 1-2, **Tortella fragilis**. 1. Habit (x4). 2. Leaves (x18). 3-6, **Tortella tortuosa**. 3. Habit (x4). 4. Portion of stem, dry (x18). 5. Leaf (x18). 6. Capsule (x9).

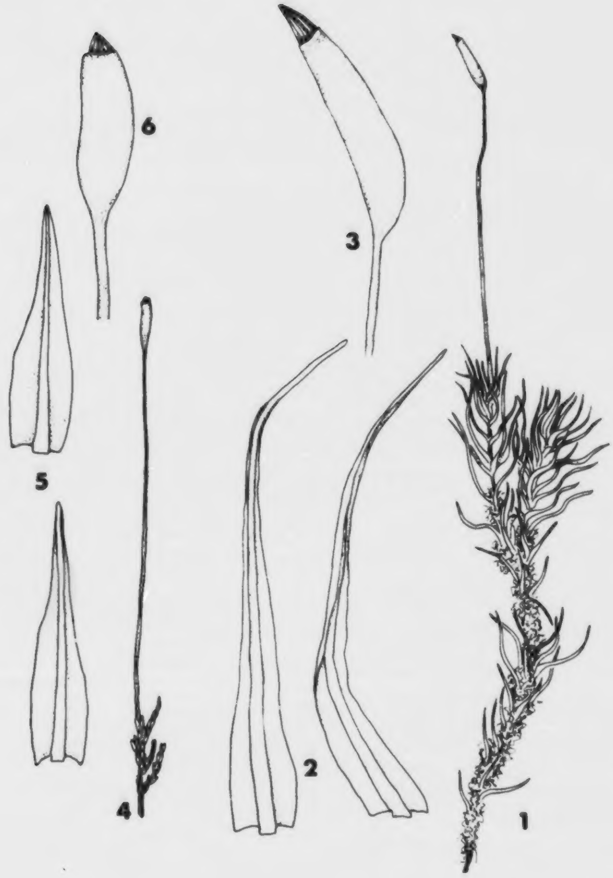

FIGURE 63. 1-3, **Ditrichum flexicaule**. 1. Habit (x4). 2. Leaves (x36). 3. Capsule (x18). 4-6, **Ditrichum lineare**. 4. Habit (x4). 5. Leaves (x36). 6. Capsule (x18).

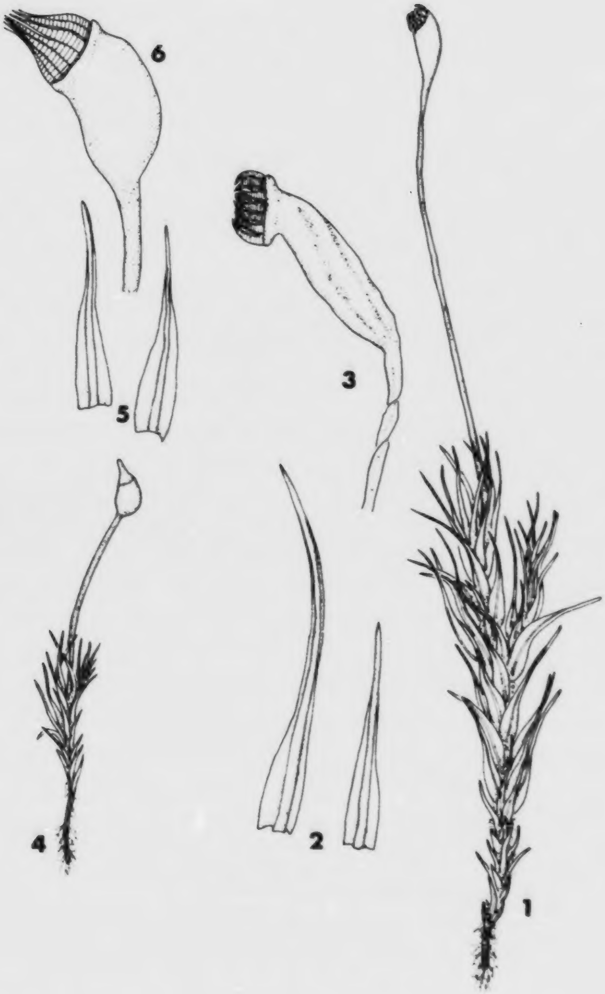

FIGURE 64. 1-3, **Dicranella heteromalla.** 1. Habit (x9). 2. Leaves (x18). 3. Capsule, dry (x36). 4-6, **Dicranella varia.** 4. Habit (x9). 5. Leaves (x18). 6. Capsule, dry (x36).

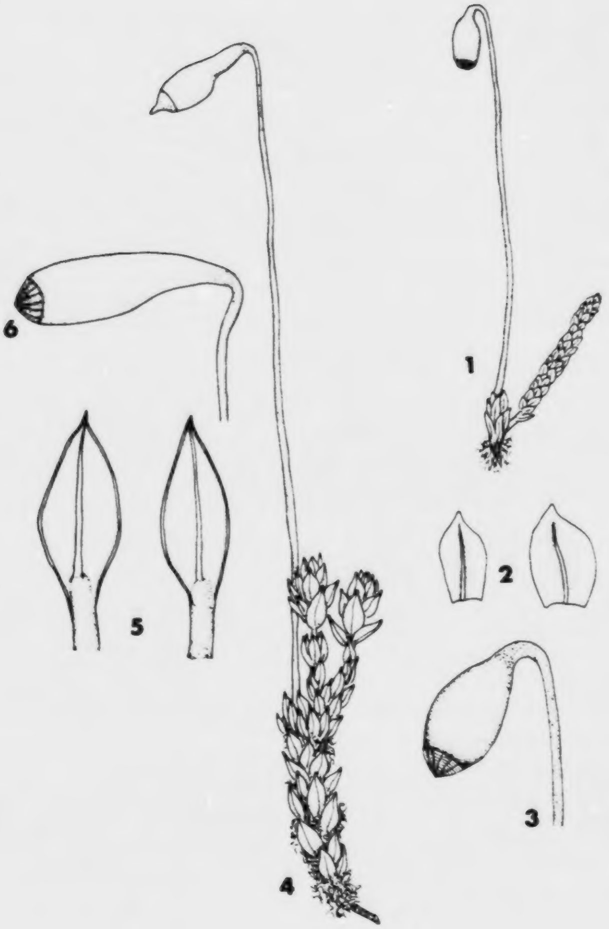

FIGURE 65. 1-3, **Bryum argenteum**. 1. Habit (x9). 2. Leaves (x36). 3. Capsule (x18). 4-6, **Bryum pseudotriquetrum**. 4. Habit (x4). 5. Leaves (x18). 6. Capsule (x9).

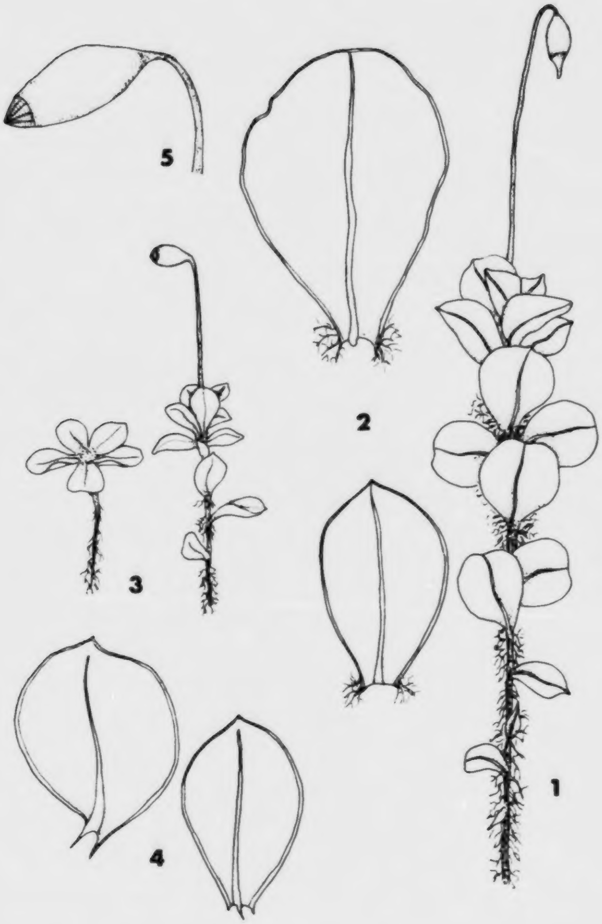

FIGURE 66. 1-2, **Rhizomnium appalachianum.** 1. Habit (x2). 2. Leaves (x9). 3-5, **Rhizomnium punctatum.** 3. Habit (x2). 4. Leaves (x9). 5. Capsule (x9).

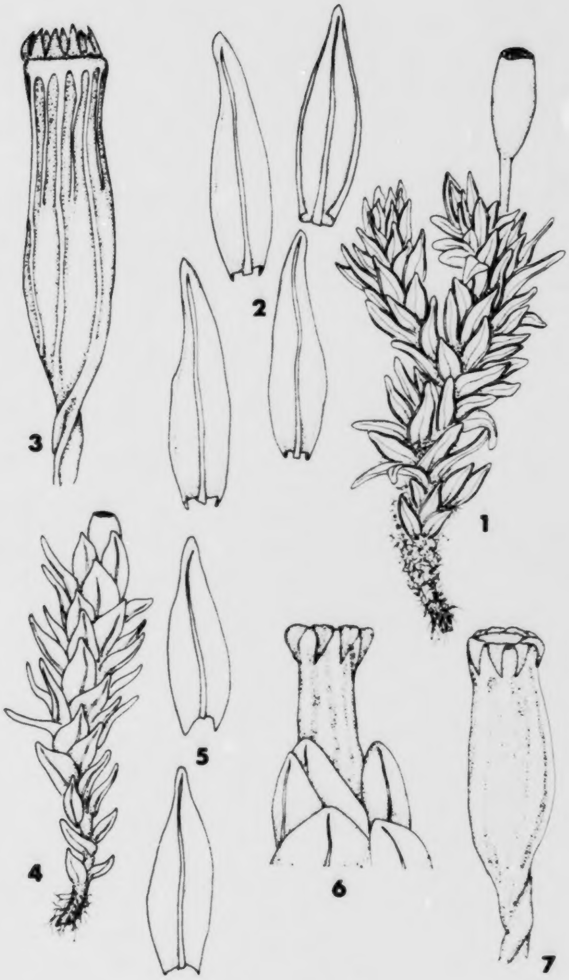

FIGURE 67. 1-3, **Orthotrichum anomalum.** 1. Habit (x9). 2. Leaves (x18). 3. Capsule, dry (x36). 4-7, **Orthotrichum obtusifolium.** 4. Habit (x9). 5. Leaves (x18). 6. Capsule and surrounding leaves, dry (x36). 7. Capsule, dry (x36).

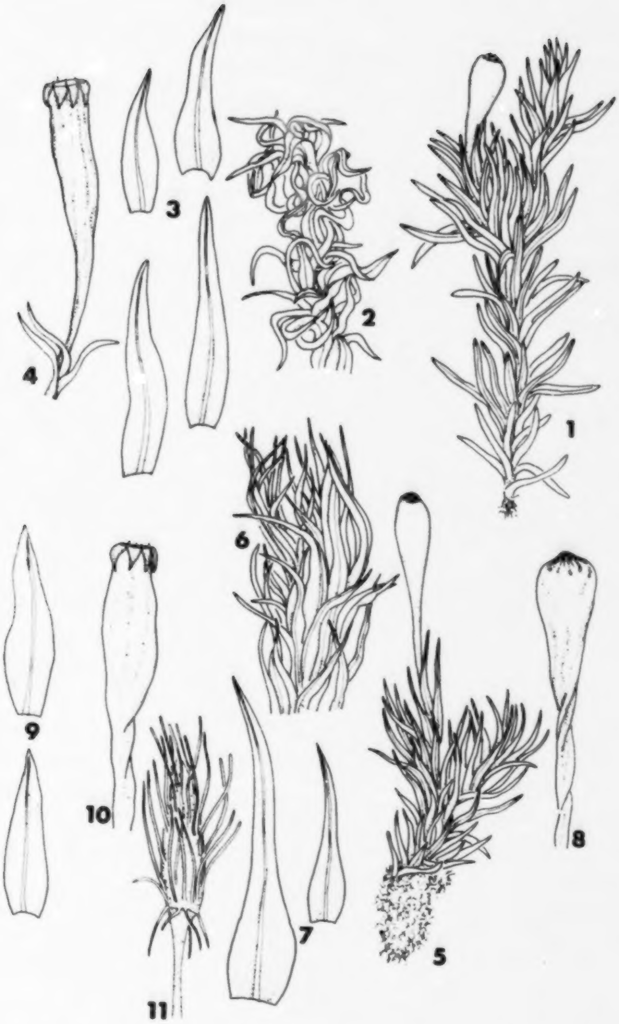

FIGURE 68. 1-4, **Ulota crispa**. 1. Habit (x9). 2. Portion of stem, dry (x18). 3. Leaves (x18). 4. Capsule, dry (x18). 5-8, **Ulota coarctata**. 5. Habit (x9). 6. Portion of stem, dry (x18). 7. Leaves (x18). 8. Capsule, dry (x18). 9-11, **Ulota hutchinsiae**. 9. Leaves (x18). 10. Capsule, dry (x18). 11. Calyptra on capsule (x18).

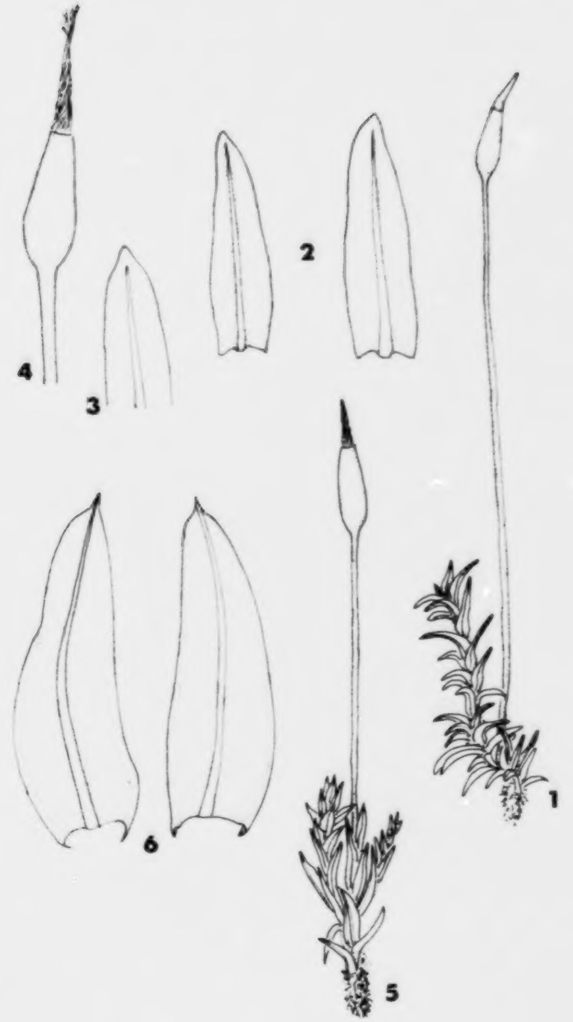

FIGURE 69. 1-4, **Barbula convoluta**. 1. Habit (x9). 2. Leaves (x36). 3. Leaf apex (x36). 4. Capsule (x18). 5-6, **Barbula unguiculata**. 5. Habit (x9). 6. Leaves (x36).

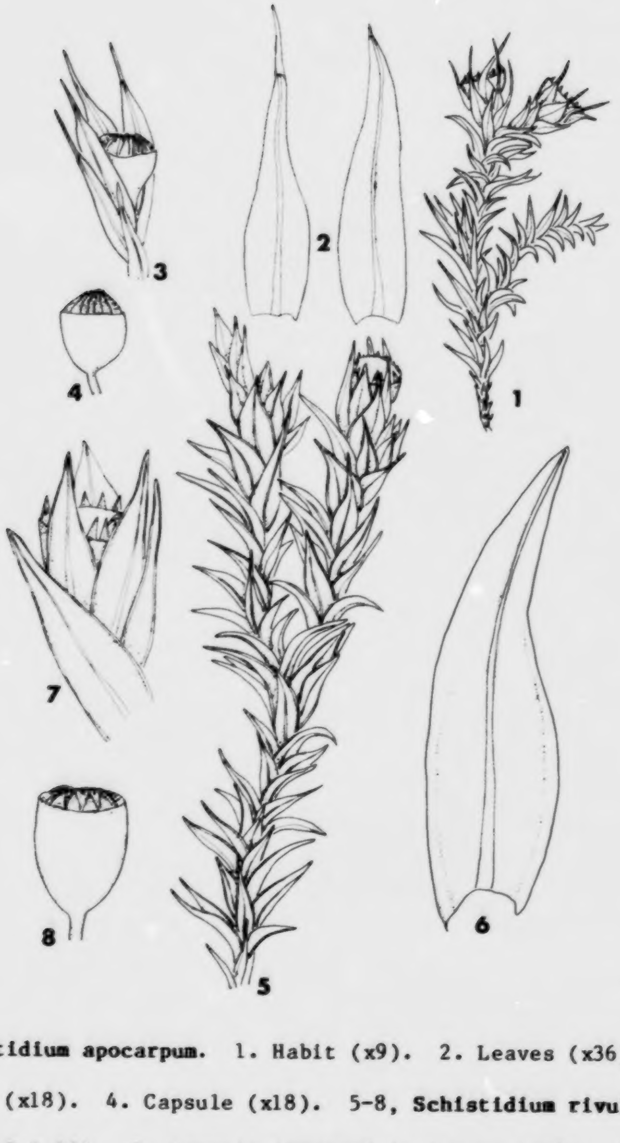

FIGURE 70. 1-4, **Schistidium apocarpum.** 1. Habit (x9). 2. Leaves (x36). 3. Capsule immersed in leaves (x18). 4. Capsule (x18). 5-8, **Schistidium rivulare.** 5. Habit (x9). 6. Leaf (x36). 7. Capsule immersed in leaves (x18). 8. Capsule (x18).

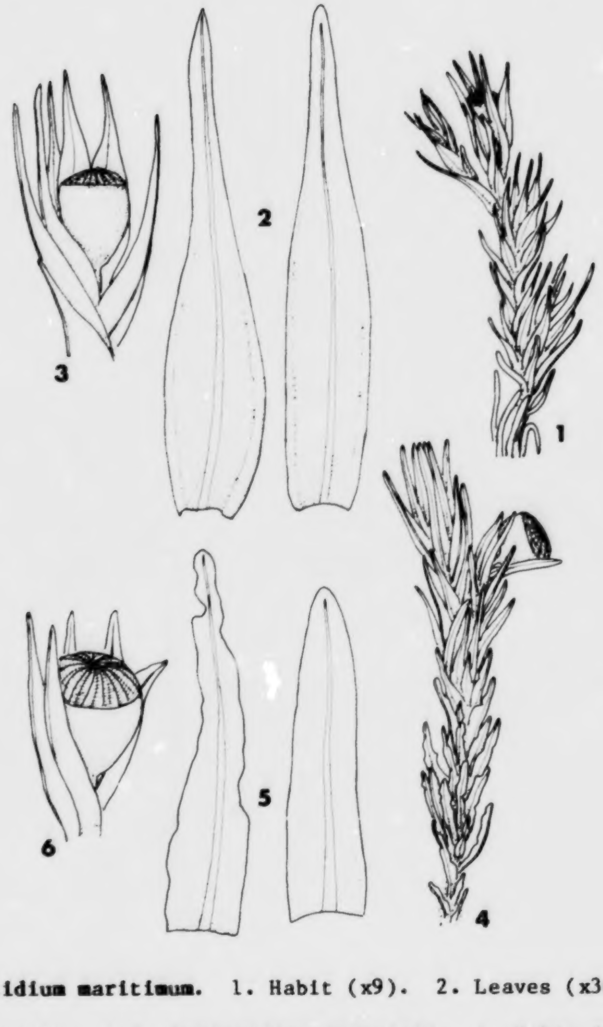

FIGURE 71. 1-3, **Schistidium maritimum.** 1. Habit (x9). 2. Leaves (x36). 3. Capsule immersed in leaves (x18). 4-6, **Schistidium agassizii.** 4. Habit (x9). 5. Leaves (x36). 6. Capsule immersed in leaves (x18).

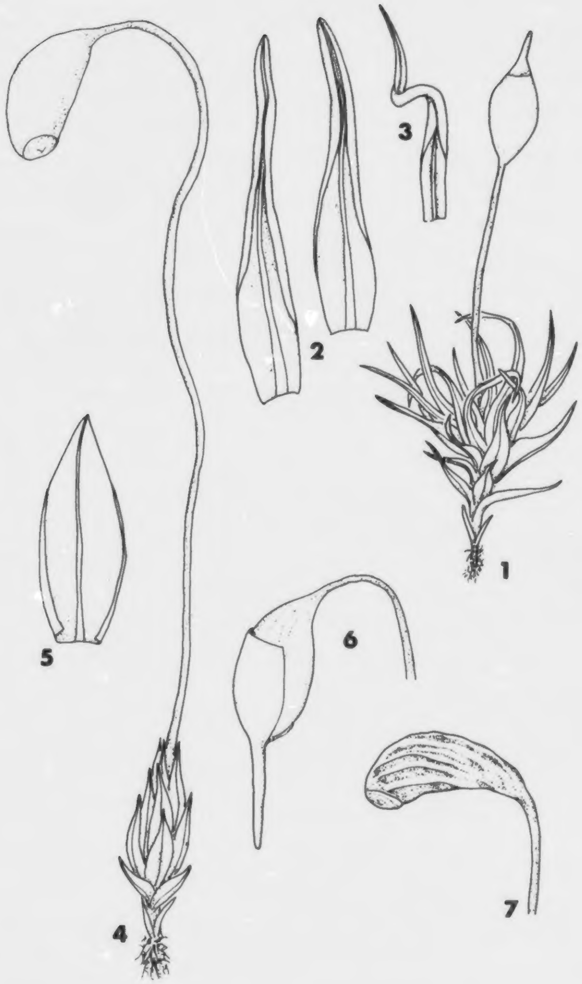

FIGURE 72. 1-3, **Weissia controversa.** 1. Habit (x18). 2. Ventral view of leaves (x36). 3. Leaf, dry (x36). 4-7, **Funaria hygrometrica.** 4. Habit (x9). 5. Leaf (x18). 6. Calyptra on capsule (x9). 7. Capsule, dry (x9).

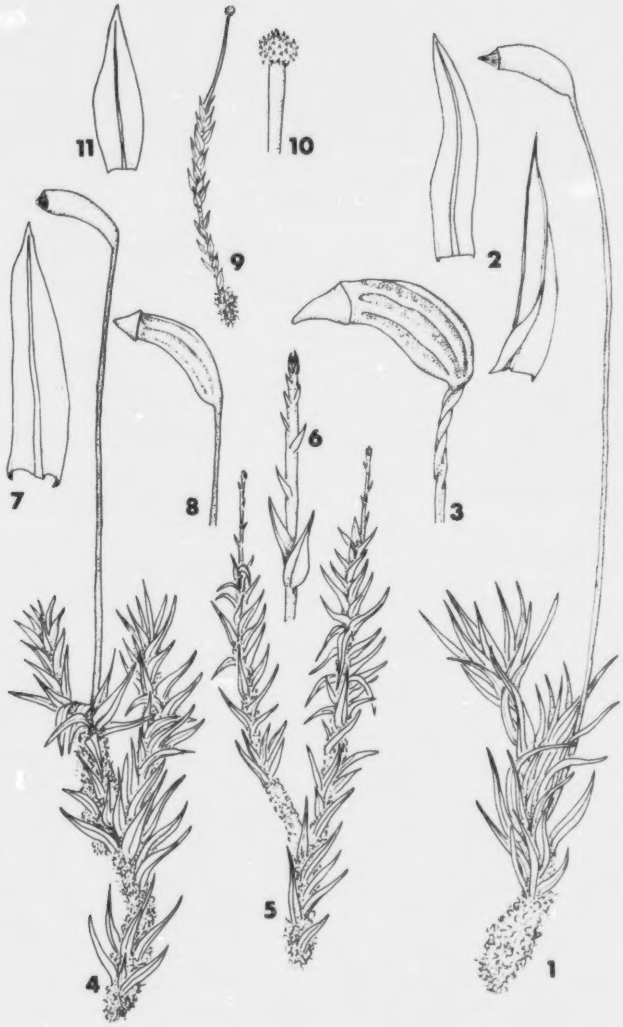

FIGURE 73. 1-3, **Ceratodon purpureus**. 1. Habit (x9). 2. Leaves (x18). 3. Capsule, dry (x18). 4-8, **Aulacomnium palustre**. 4. Habit (x4). 5. Habit of gemmiferous plant (x4). 6. Apex of gemmiferous shoot (x18). 7. Leaf (x18). 8. Capsule, dry (x9). 9-11, **Aulacomnium androgynum**. 9. Habit of gemmiferous plant (x4). 10. Apex of gemmiferous shoot (x18). 11. Leaf (x18).

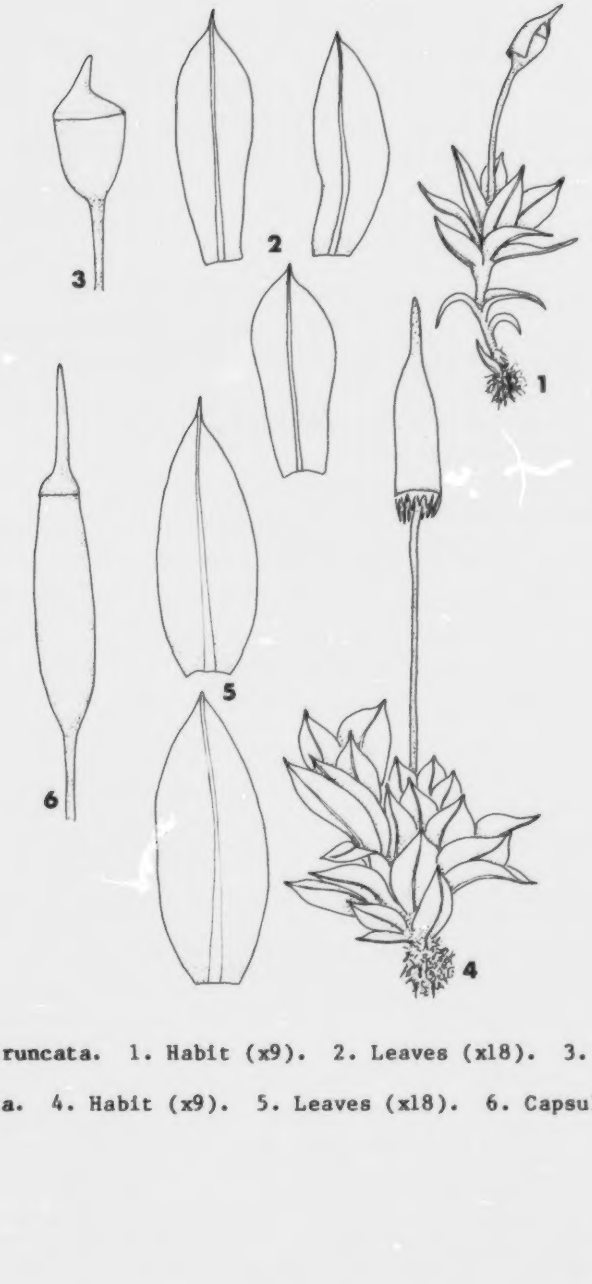

FIGURE 74. 1-3, **Pottia truncata**. 1. Habit (x9). 2. Leaves (x18). 3. Capsule (x18). 4-6, **Encalypta ciliata**. 4. Habit (x9). 5. Leaves (x18). 6. Capsule (x18).

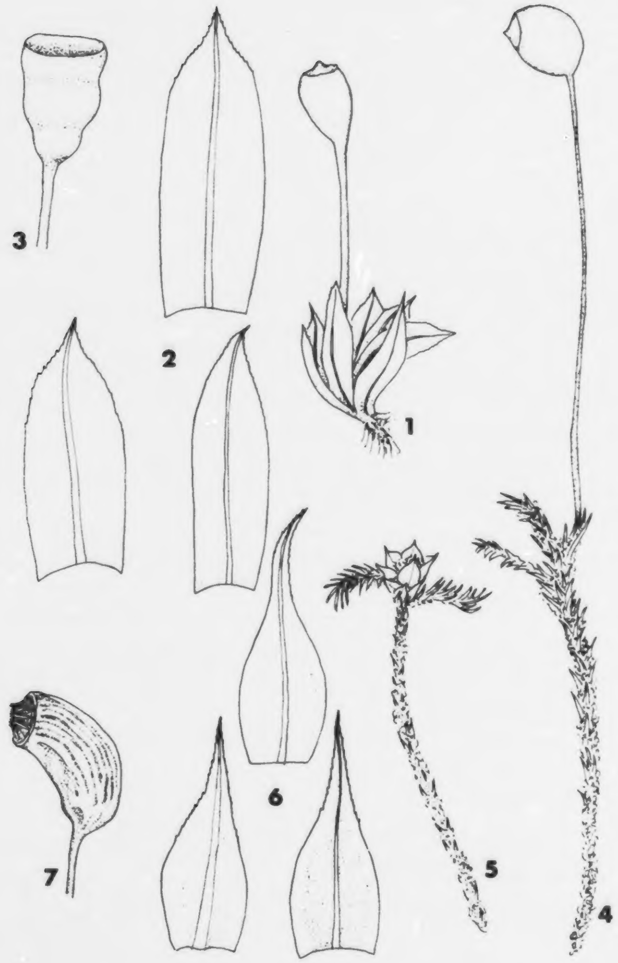

FIGURE 75. 1-3, **Physcomitrium pyriforme**. 1. Habit (x9). 2. Leaves (x18). 3. Capsule, dry (x18). 4-7, **Philonotis fontana**. 4. Habit of female plant with sporophyte (x4). 5. Habit of male plant (x4). 6. Leaves (x36). 7. Capsule, dry (x9).

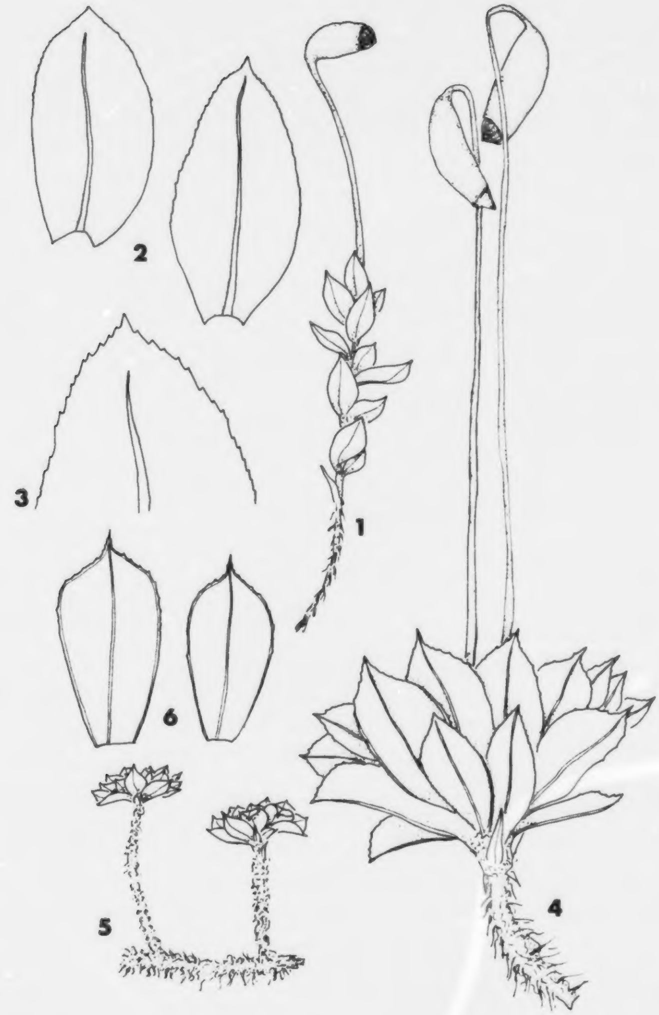

FIGURE 76. 1-3, **Mnium stellare.** 1. Habit (x4). 2. Leaves (x18). 3. Leaf apex showing teeth (x36). 4-6, **Rhodobryum ontariense.** 4. Habit (x2). 5. Habit of two plants (x3/4). 6. Leaves (x4).

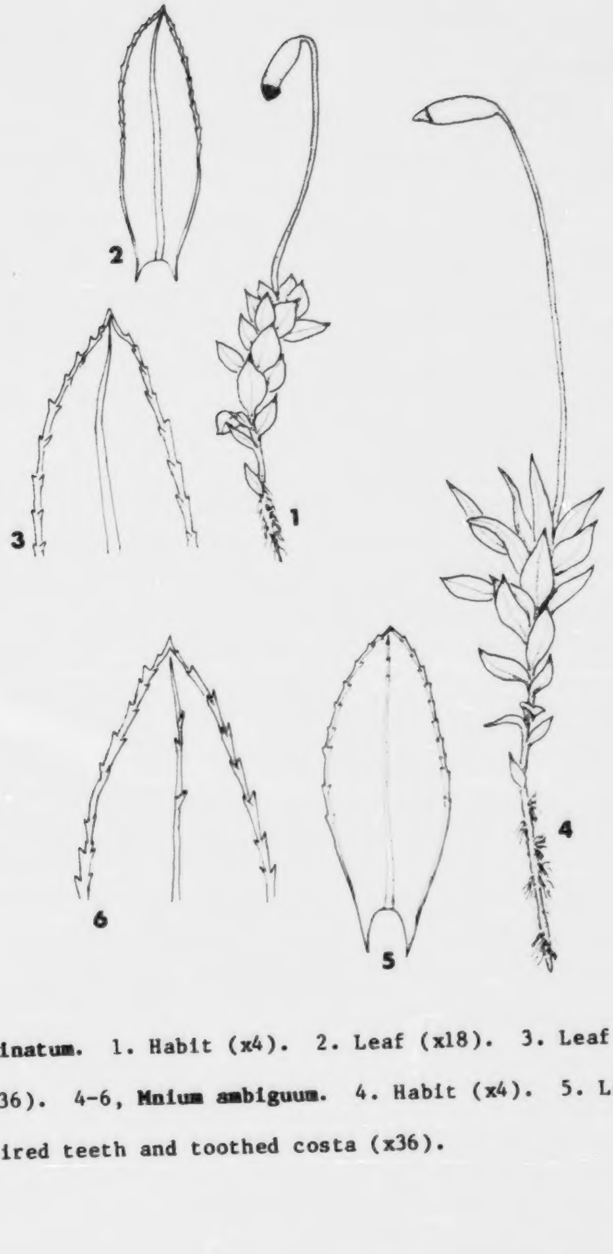

FIGURE 77. 1-3, **Mnium marginatum**. 1. Habit (x4). 2. Leaf (x18). 3. Leaf apex showing paired teeth (x36). 4-6, **Mnium ambiguum**. 4. Habit (x4). 5. Leaf (x18). 6. Leaf apex showing paired teeth and toothed costa (x36).

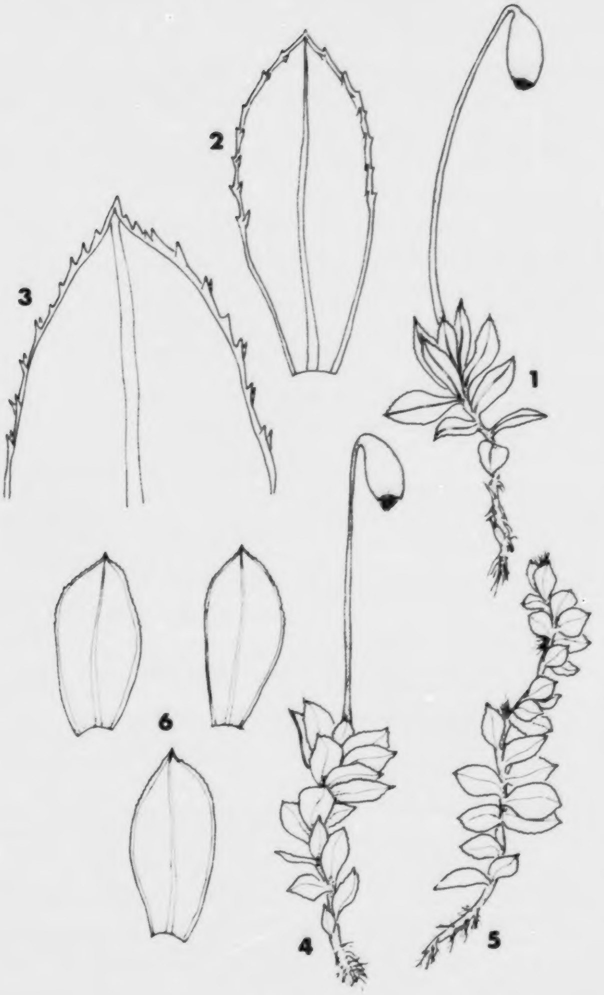

FIGURE 78. 1-3, **Mnium spinulosum.** 1. Habit (x4). 2. Leaf (x18). 3. Leaf apex showing paired teeth (x36). 4-6, **Plagiomnium cuspidatum.** 4. Habit (x4). 5. 5. Habit of stoloniferous plant (x4). 6. Leaves (x9).

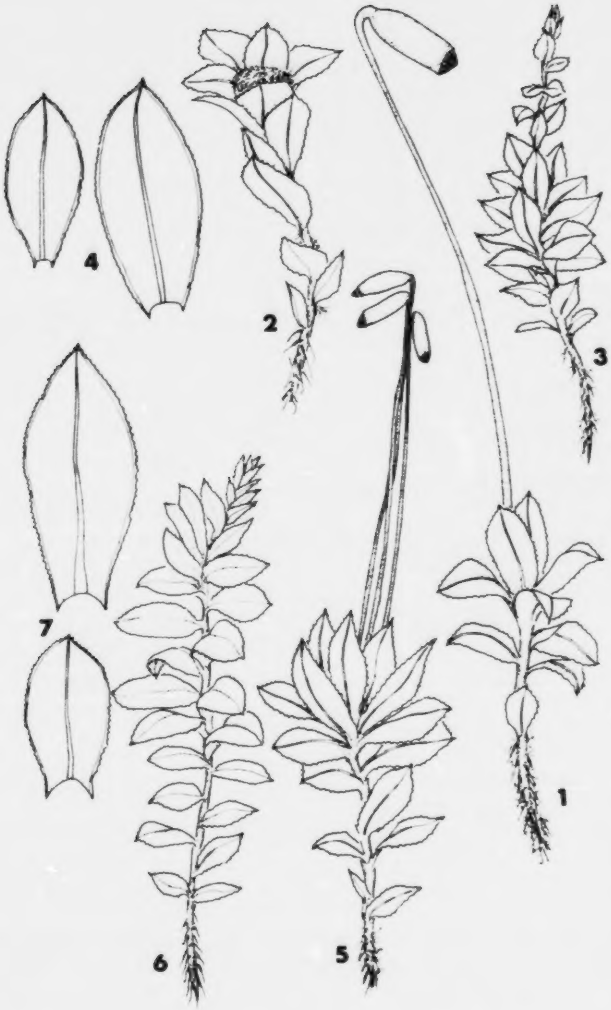

FIGURE 79. 1-4, **Plagiomnium ciliare**. 1. Habit of female plant with sporophyte (x4). 2. Habit of male plant (x4). 3. Habit of stoloniferous plant (x4). 4. Leaves (x9). 5-7, **Plagiomnium medium**. 5. Habit (x2). 6. Habit of stoloniferous plant (x2). 7. Leaves (x4).

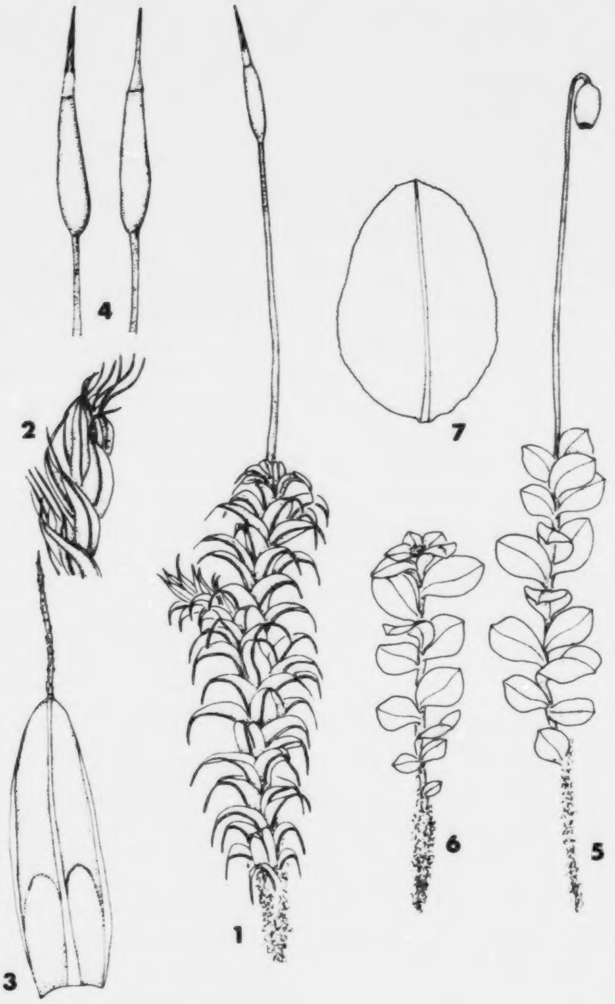

FIGURE 80. 1-4, **Tortula ruralis.** 1. Habit (x4). 2. Upper portion of plant, dry (x4). 3. Leaf (x18). 4. Capsules, operculate and inoperculate (x9). 5-7, **Pseudobryum cinclidioides.** 5. Habit of female plant with sporophyte (x2). 6. Habit of male plant (x2). 7. Leaf (x9).

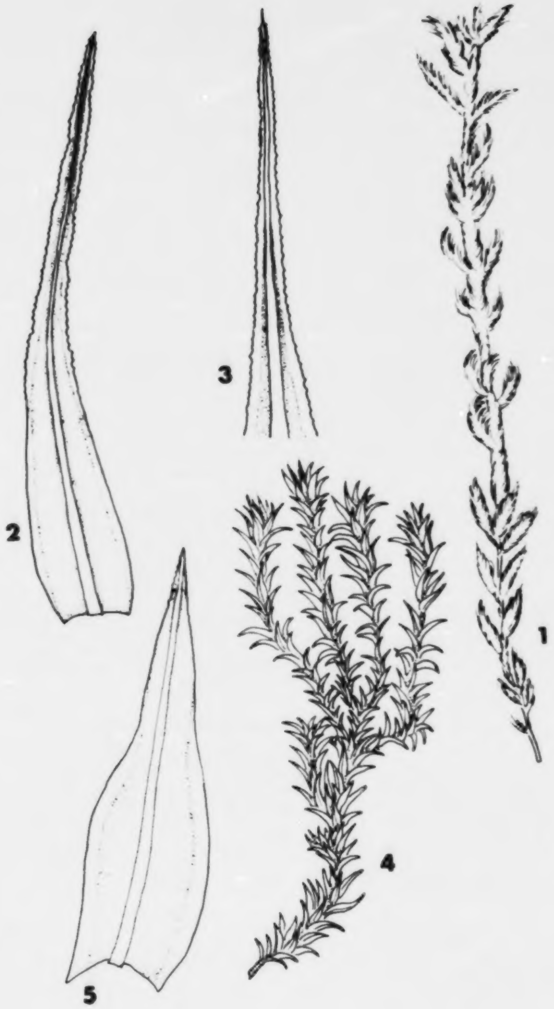

FIGURE 81. 1-3, **Rhacomitrium lanuginosum**. 1. Habit (x2). 2. Leaf (x30). 3. Leaf apex (x36). 4-5, **Rhacomitrium canescens**. 4. Habit (x2). 5. Leaf (x36).

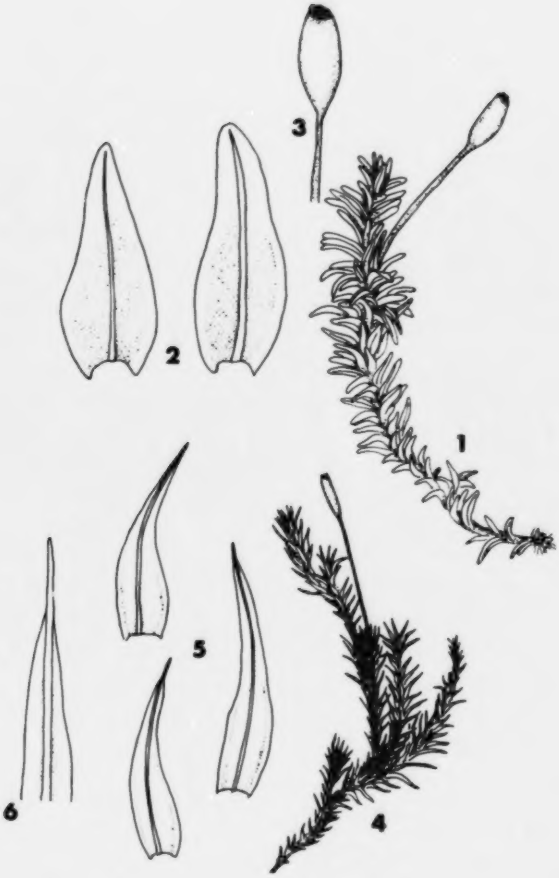

FIGURE 82. 1-3, **Rhacomitrium aciculare**. 1. Habit (x4). 2. Leaves (x18). 3. Capsule (x9). 4-6, **Rhacomitrium heterostichum**. 4. Habit (x4). 5. Leaves (x18). 6. Leaf apex (x36).

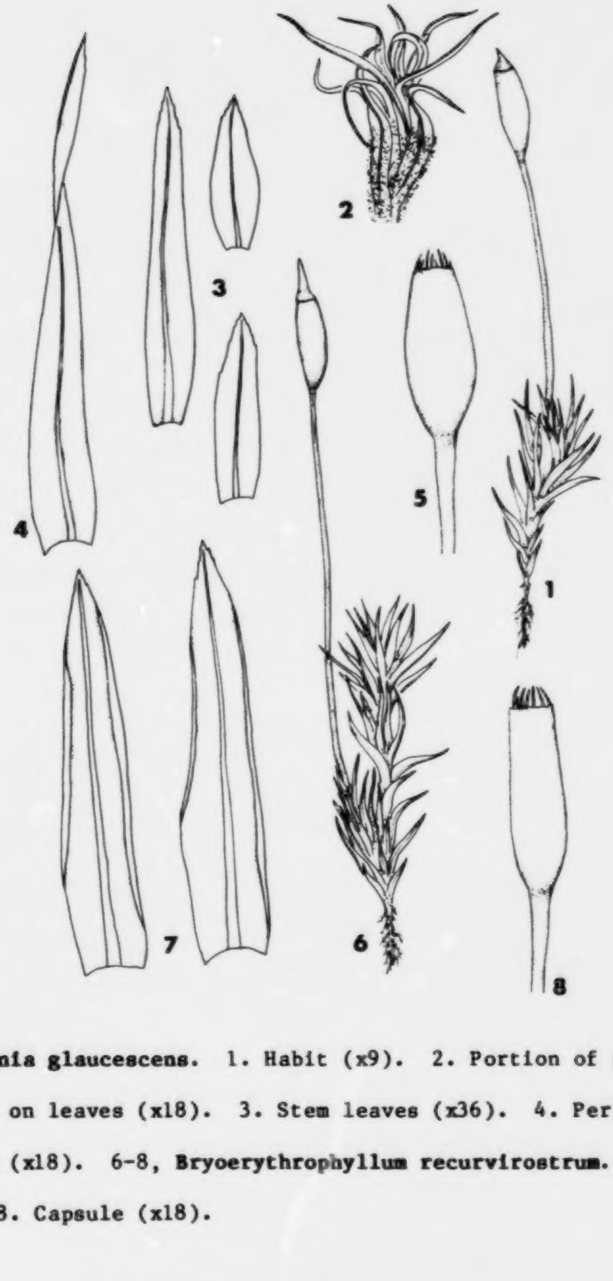

FIGURE 83. 1-5, **Saelania glaucescens.** 1. Habit (x9). 2. Portion of stem showing cobwebby substance on leaves (x18). 3. Stem leaves (x36). 4. Perichaetial leaf (x36). 5. Capsule (x18). 6-8, **Bryoerythrophyllum recurvirostrum.** 6. Habit (x9). 7. Leaves (x36). 8. Capsule (x18).

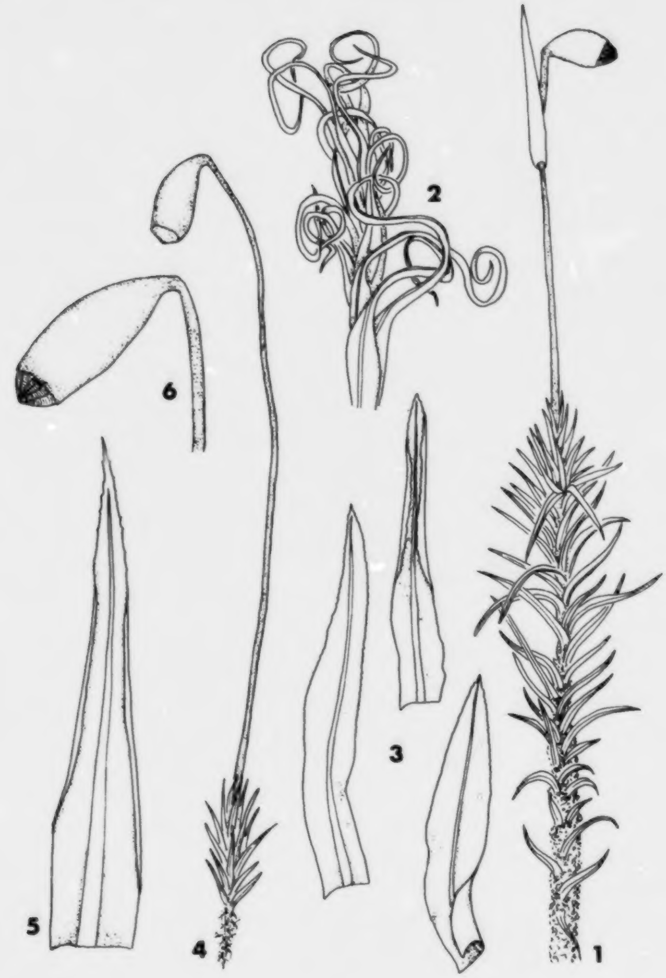

FIGURE 84. 1-3, **Timmia megapolitana.** 1. Habit showing calyptrae attached to seta (x3). 2. Portion of stem, dry (x9). 3. Leaves (x9). 4-6, **Pohlia nutans.** 4. Habit (x4). 5. Leaf (x36). 6. Capsule (x9).

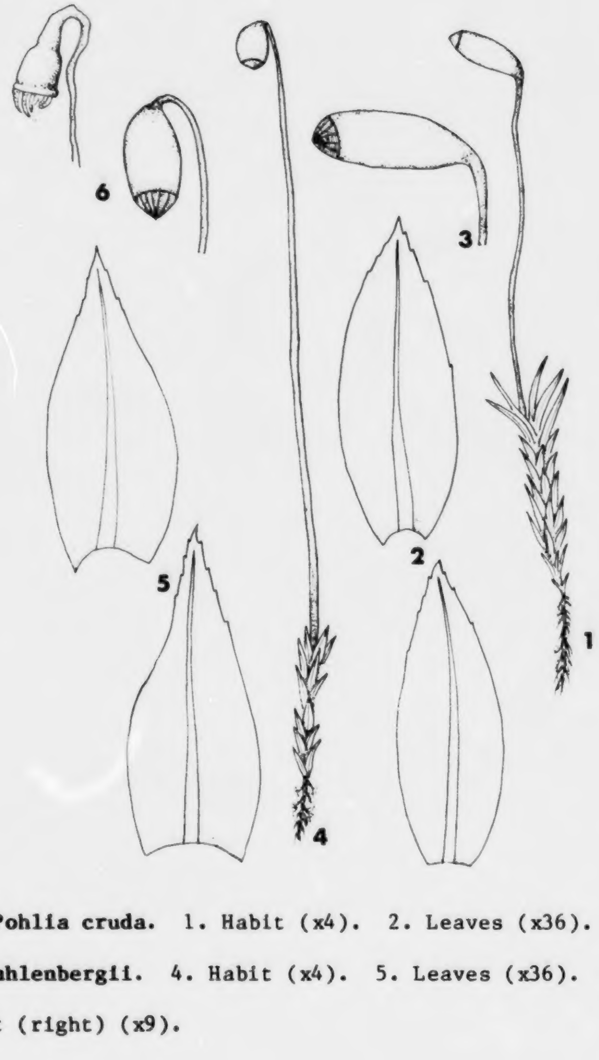

FIGURE 85. 1-3, **Pohlia cruda.** 1. Habit (x4). 2. Leaves (x36). 3. Capsule (x9). 4-6, **Pohlia wahlenbergii.** 4. Habit (x4). 5. Leaves (x36). 6. Capsules, dry (left) and wet (right) (x9).

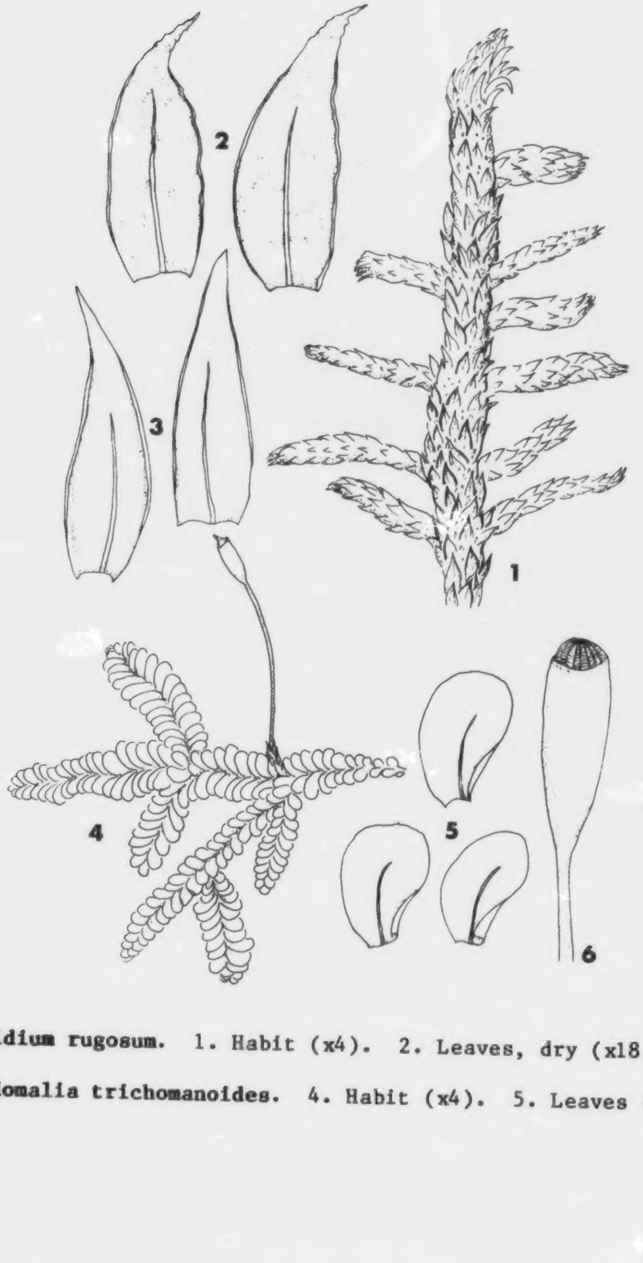

FIGURE 86. 1-3, **Rhytidium rugosum.** 1. Habit (x4). 2. Leaves, dry (x18). 3. Leaves, wet (x18). 4-6, **Homalia trichomanoides.** 4. Habit (x4). 5. Leaves (x18). 6. Capsule (x18).

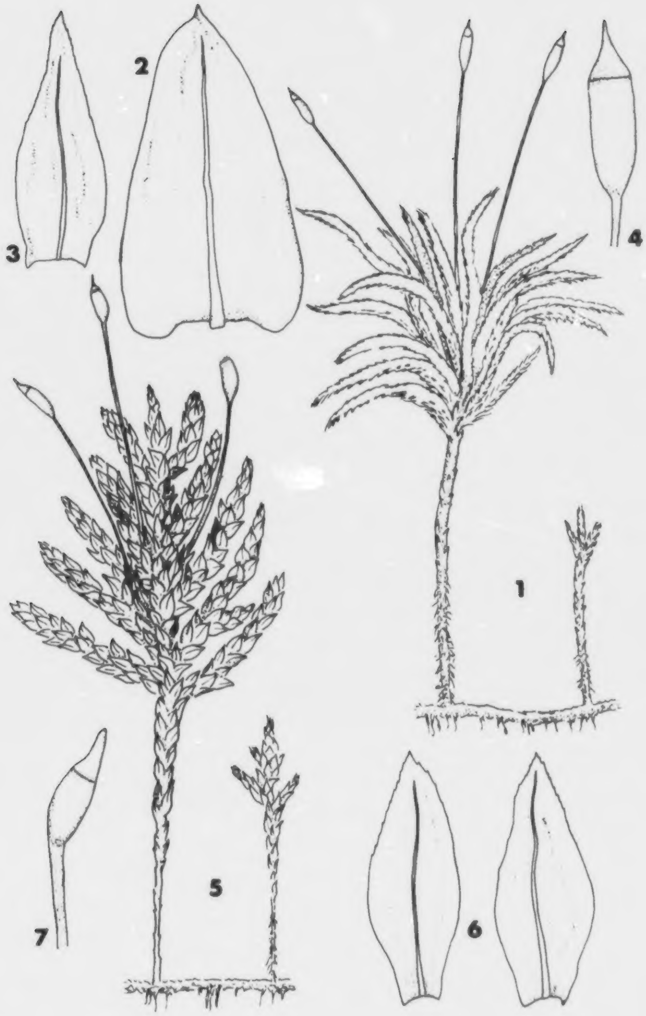

FIGURE 87. 1-4, **Climacium dendroides.** 1. Habit (x1). 2. Stem leaf (x18). 3. Branch leaf (x18). 4. Capsule (x9). 5-7, **Thamnobryum alleghaniense.** 5. Habit (x1). 6. Branch leaves (x18). 7. Capsule (x4).

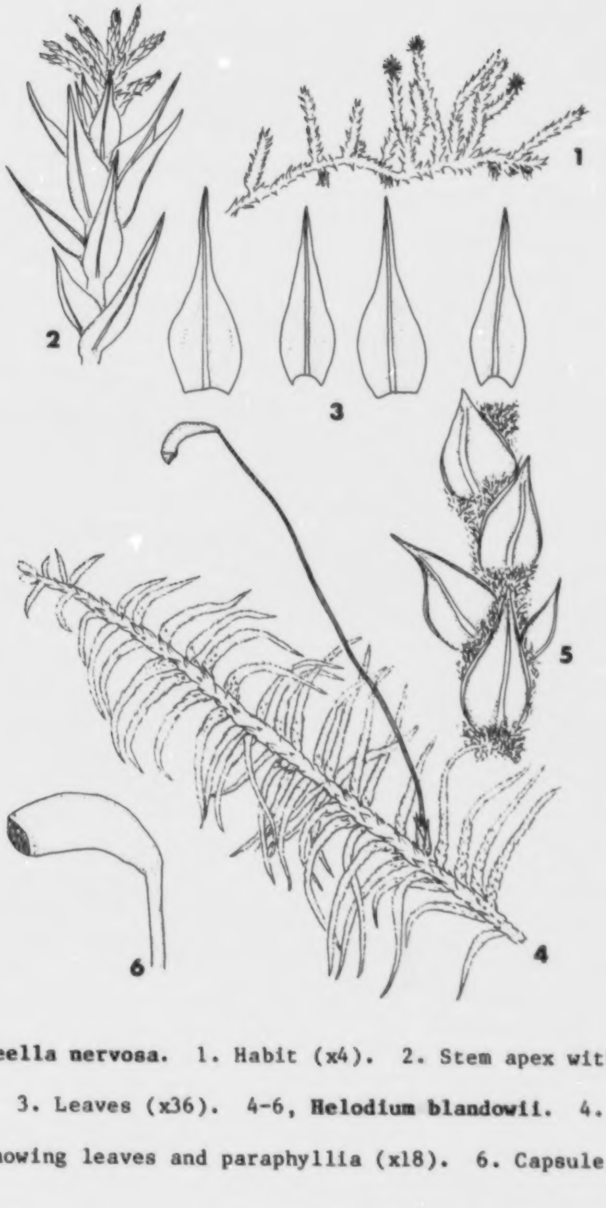

FIGURE 88. 1-3, **Leskeella nervosa.** 1. Habit (x4). 2. Stem apex with microphyllous branchlets (x36). 3. Leaves (x36). 4-6, **Helodium blandowii.** 4. Habit (x1). 5. Portion of stem showing leaves and paraphyllia (x18). 6. Capsule (x9).

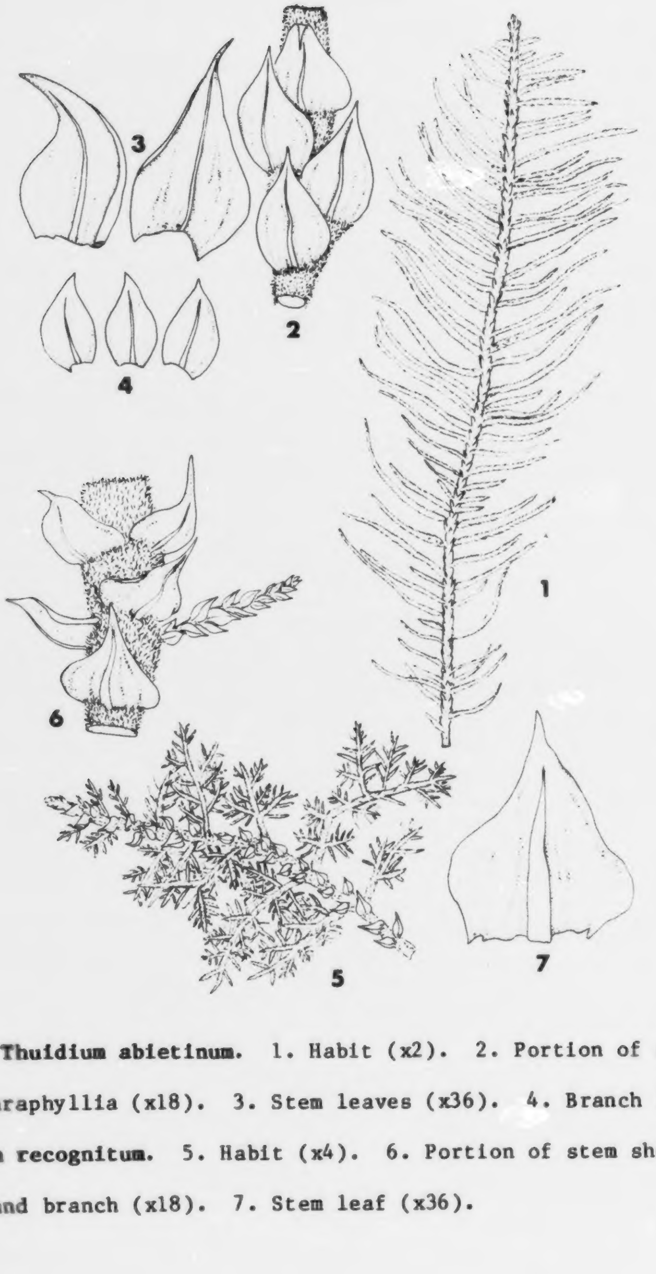

FIGURE 89. 1-4, **Thuidium abietinum**. 1. Habit (x2). 2. Portion of stem showing leaves and paraphyllia (x18). 3. Stem leaves (x36). 4. Branch leaves (x36). 5-7, **Thuidium recognitum**. 5. Habit (x4). 6. Portion of stem showing leaves, paraphyllia and branch (x18). 7. Stem leaf (x36).

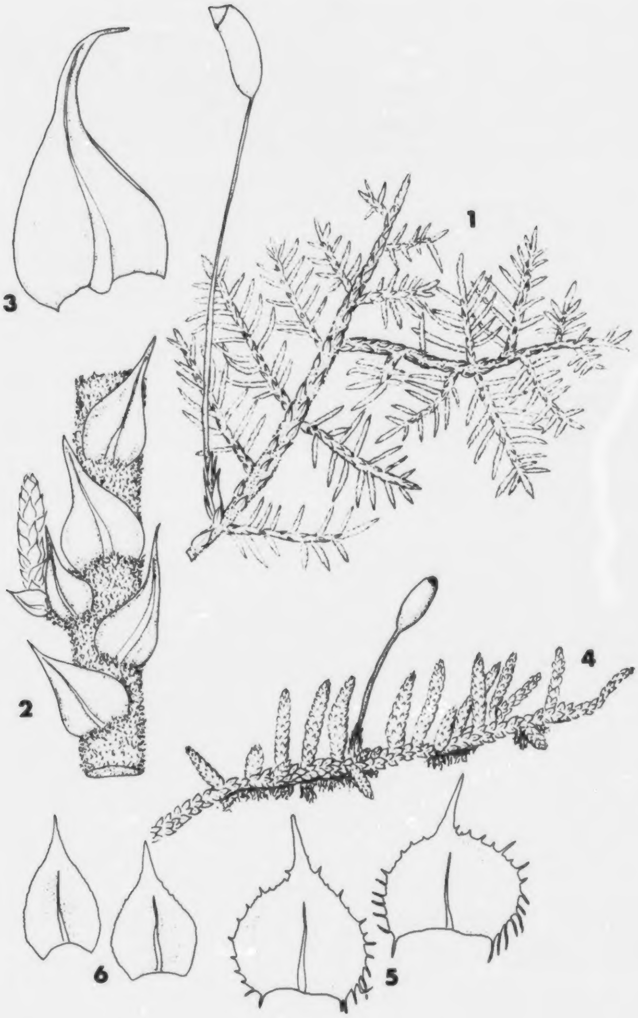

FIGURE 90. 1-3, **Thuidium delicatulum.** 1. Habit (x4). 2. Portion of stem showing leaves, paraphyllia and branch (x18). 3. Stem leaf (x36). 4-6, **Thelia hirtella.** 4. Habit (x4). 5. Stem leaves (x36). 6. Branch leaves (x36).

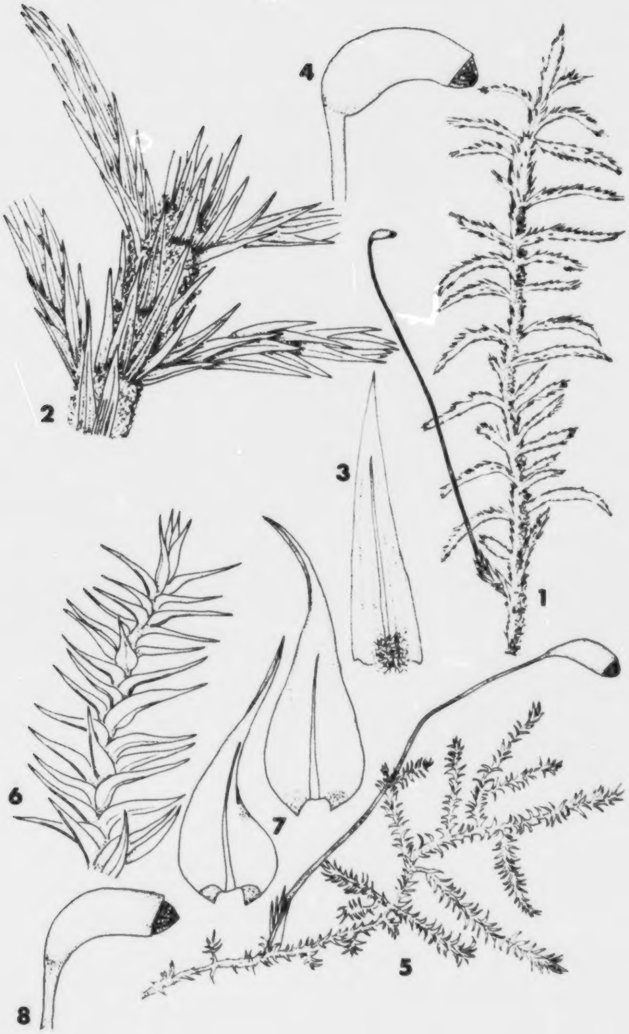

FIGURE 91. 1-4, **Tomenthypnum nitens**. 1. Habit (x1). 2. Portion of stem showing rhizoids and branches (x9). 3. Leaf (x18). 4. Capsule (x9). 5-8, **Campylium chrysophyllum**. 5. Habit (x4). 6. Portion of stem (x18). 7. Leaves (x36). 8. Capsule (x9).

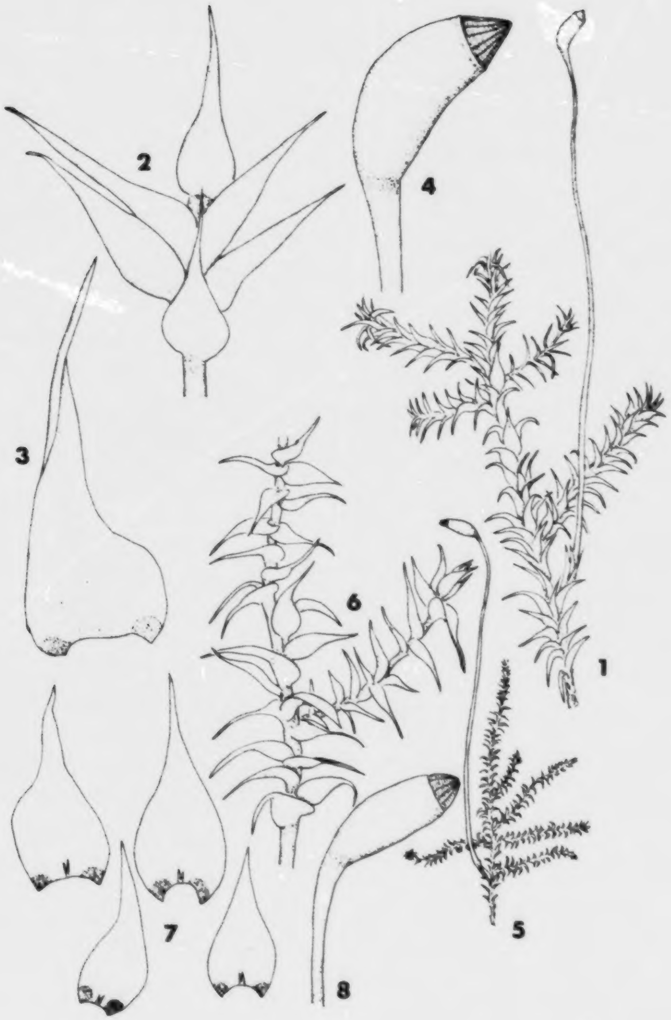

FIGURE 92. 1-4, **Campylium stellatum.** 1. Habit (x4). 2. Portion of stem (x18). 3. Leaf (x36). 4. Capsule (x18). 5-8, **Campylium hispidulum.** 5. Habit (x4). 6. Portion of stem and branch (x18). 7. Leaves (x36). 8. Capsule (x18).

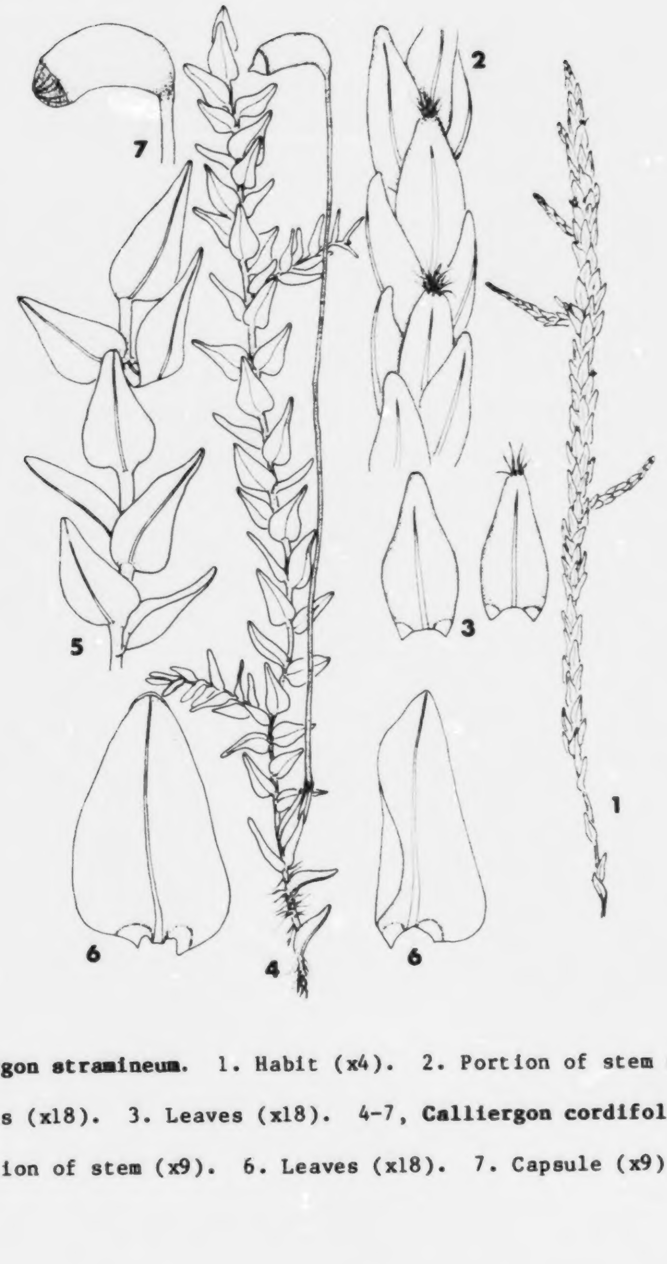

FIGURE 93. 1-3, **Calliergon stramineum**. 1. Habit (x4). 2. Portion of stem showing rhizoids on leaf tips (x18). 3. Leaves (x18). 4-7, **Calliergon cordifolium**. 4. Habit (x4). 5. Portion of stem (x9). 6. Leaves (x18). 7. Capsule (x9).

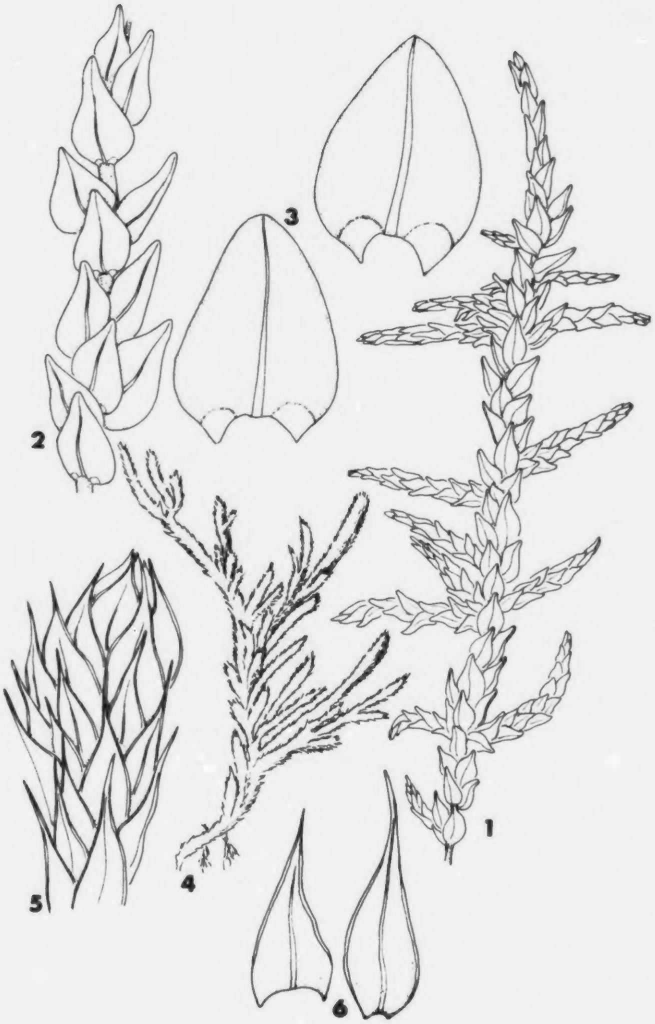

FIGURE 94. 1-3, **Calliergon giganteum**. 1. Habit (x4). 2. Portion of stem (x9). 3. Leaves (x18). 4-6, **Anomodon rostratus**. 4. Habit (x4). 5. Stem apex (x36). 6. Leaves (x36).

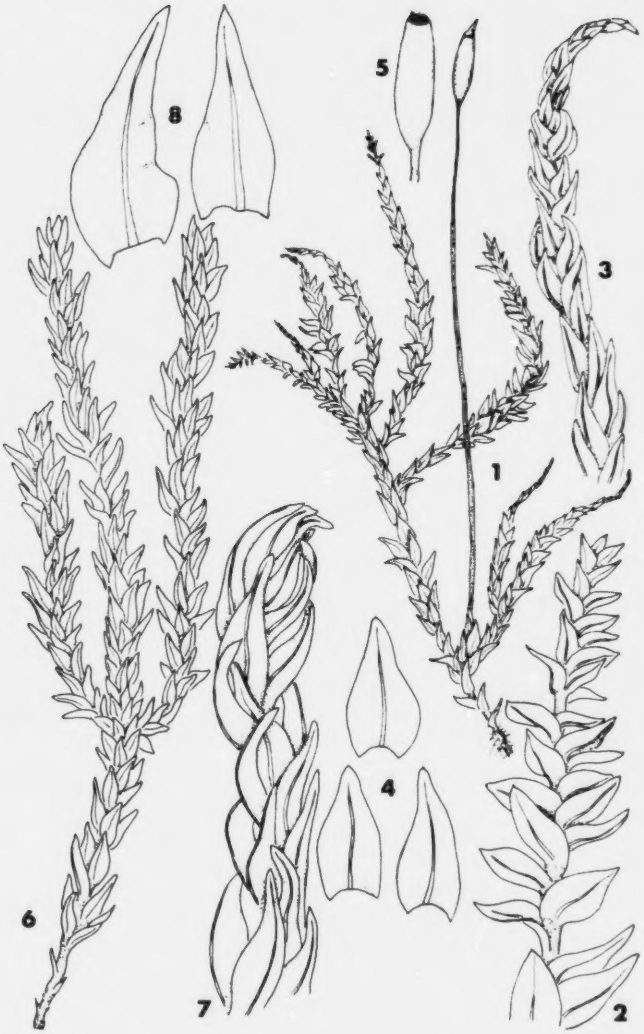

FIGURE 95. 1-5, **Anomodon attenuatus.** 1. Habit (x4). 2. Stem apex, wet (x18). 3. Stem apex, dry (x18). 4. Leaves (x18). 5. Capsule (x9). 6-8, **Anomodon viticulosus.** 6. Habit (x4). 7. Stem apex, dry (x18). 8. Leaves (x18).

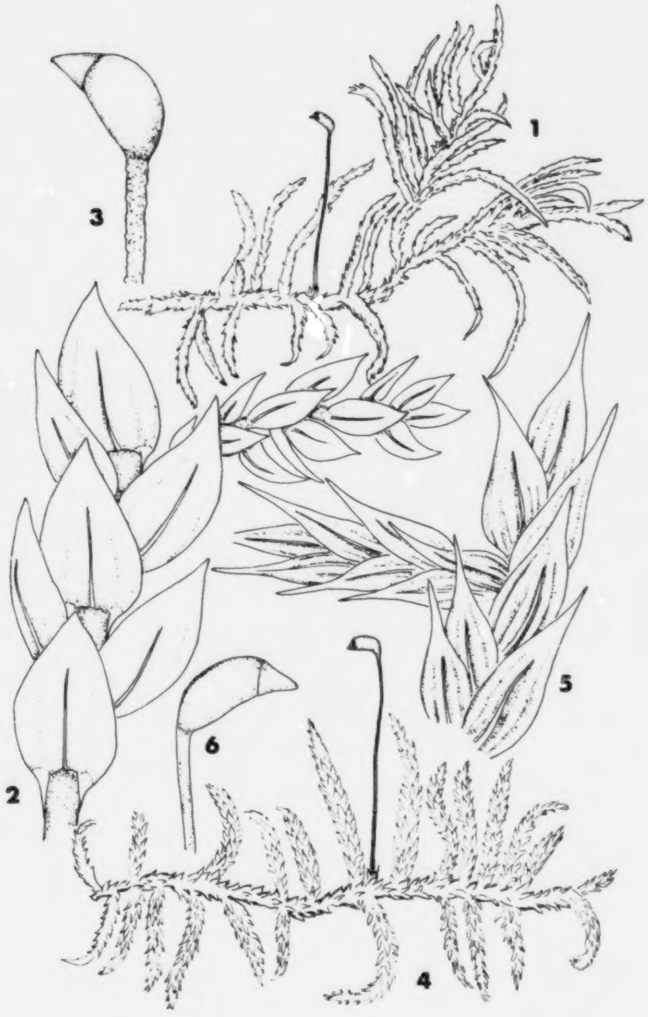

FIGURE 96. 1-3, **Brachythecium rivulare**. 1. Habit (x2). 2. Portion of stem and branch (x18). 3. Capsule (x9). 4-6, **Brachythecium salebrosum**. 4. Habit (x2). 5. Portion of stem and branch (x18). 6. Capsule (x9).

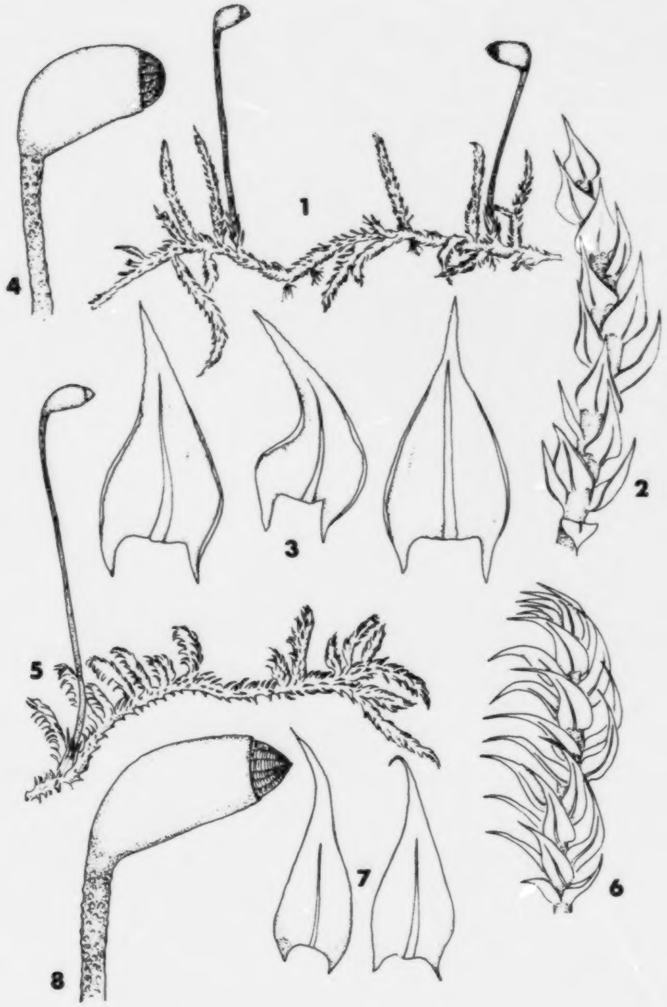

FIGURE 97. 1-4, **Brachythecium reflexum**. 1. Habit (x4). 2. Portion of branch (x18). 3. Stem leaves (x36). 4. Capsule (x18). 5-8, **Brachythecium velutinum**. 5. Habit (x4). 6. Portion of branch (x18). 7. Stem leaves (x36). 8. Capsules (x18).

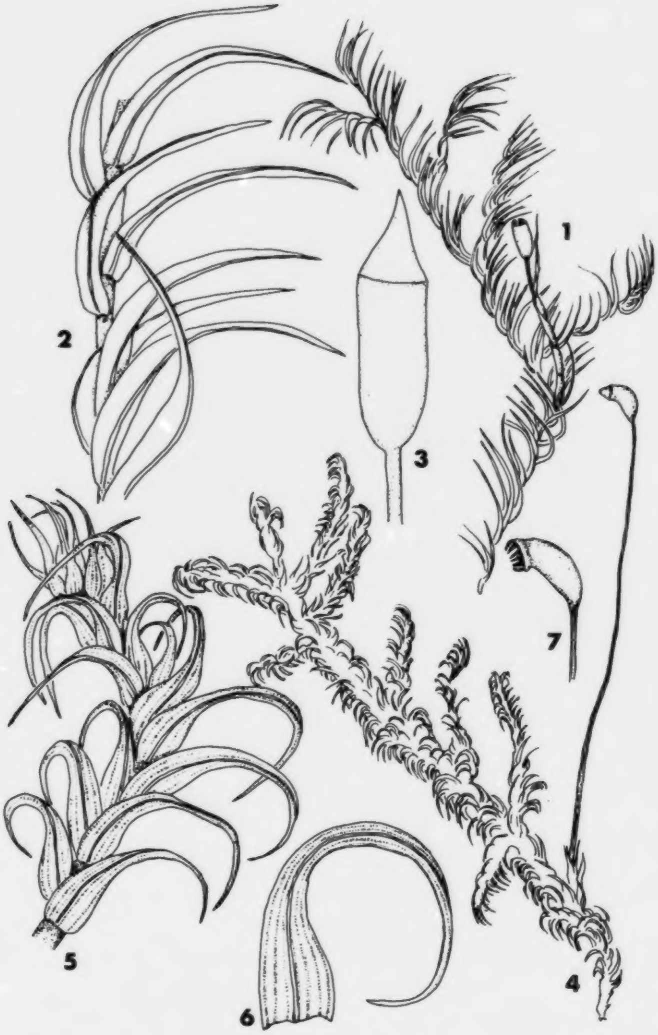

FIGURE 98. 1-3, **Dichelyma pallescens**. 1. Habit (x4). 2. Portion of stem (x18). 3. Capsule (x18). 4-7, **Drepanocladus uncinatus**. 4. Habit (x4). 5. Portion of stem and branch (x18). 6. Stem leaf (x36). 7. Capsule, dry (x9).

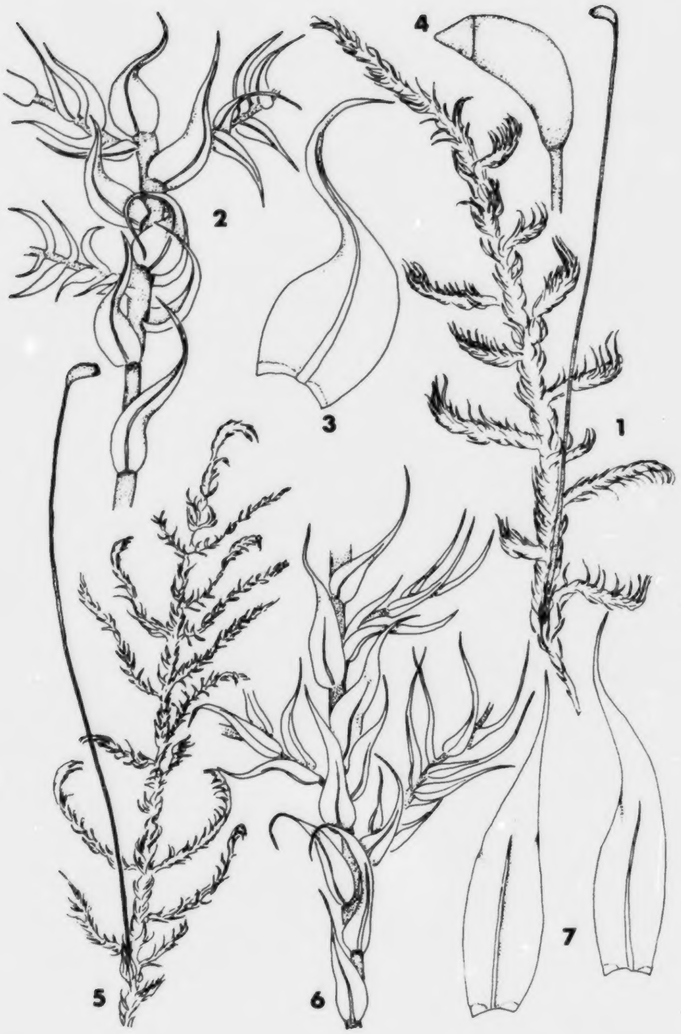

FIGURE 99. 1-4, **Drepanocladus exannulatus**. 1. Habit (x2). 2. Portion of stem and branches (x9). 3. Stem leaf (x18). 4. Capsule (x9). 5-7, **Drepanocladus fluitans**. 5. Habit (x2). 6. Portion of stem and branches (x9). 7. Stem leaves (x18).

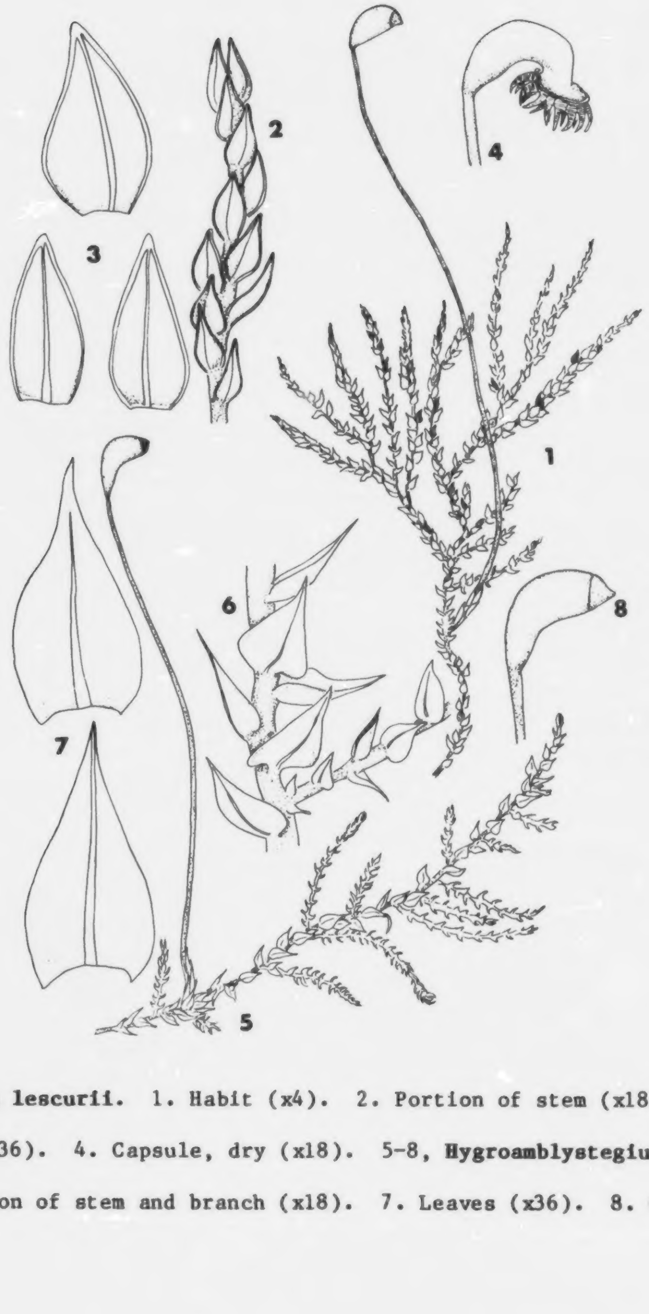

FIGURE 100. 1-4, **Sciaromium lescurii.** 1. Habit (x4). 2. Portion of stem (x18). 3. Leaves showing border (x36). 4. Capsule, dry (x18). 5-8, **Hygroamblystegium tenax.** 5. Habit (x4). 6. Portion of stem and branch (x18). 7. Leaves (x36). 8. Capsule (x9).

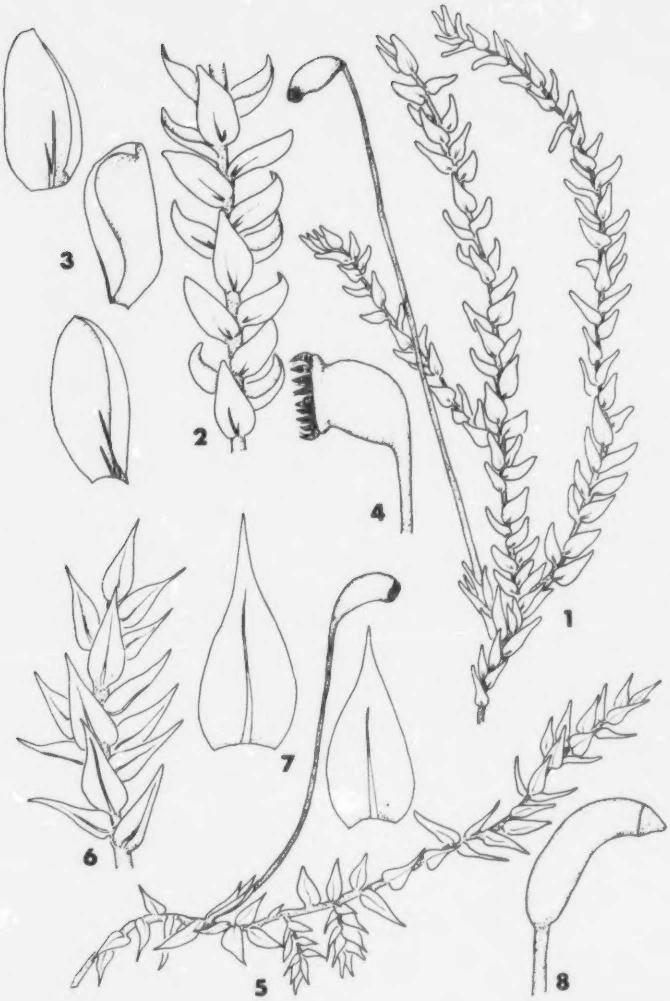

FIGURE 101. 1-4, **Hygrohypnum ochraceum.** 1. Habit (x4). 2. Portion of stem (x9). 3. Leaves (x18). 4. Capsule, dry (x9). 5-8, **Leptodictyum riparium.** 5. Habit (x4). 6. Portion of stem (x9). 7. Leaves (x18). 8. Capsule (x9).

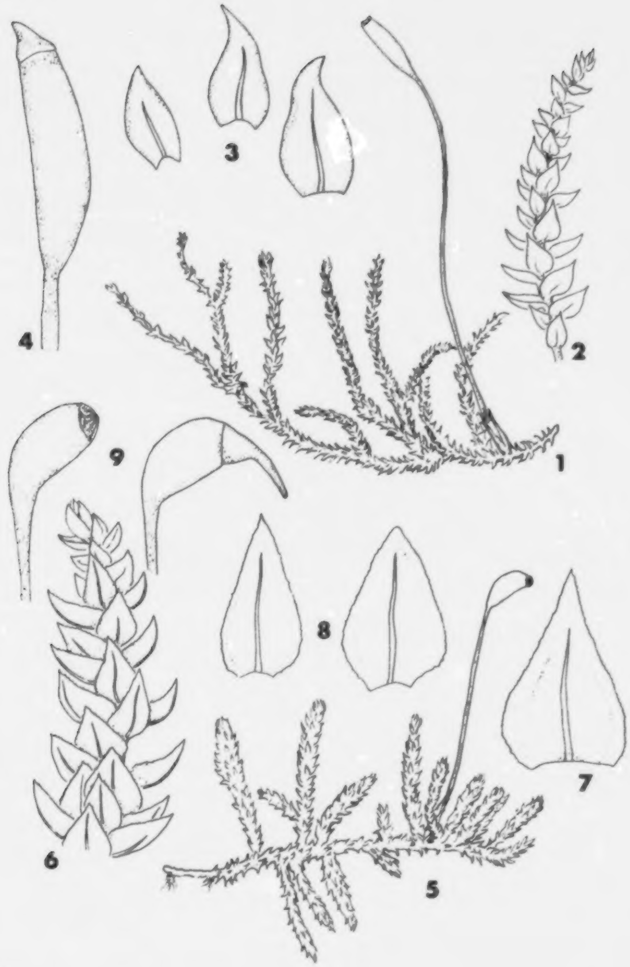

FIGURE 102. 1-4, **Leskea polycarpa**. 1. Habit (x9). 2. Portion of branch (x18). 3. Leaves (x36). 4. Capsule, wet (x18). 5-9, **Eurhynchium pulchellum**. 5. Habit (x4). 6. Portion of branch (x18). 7. Stem leaf (x36). 8. Branch leaves (x36). 9. Capsules, operculate and inoperculate (x9).

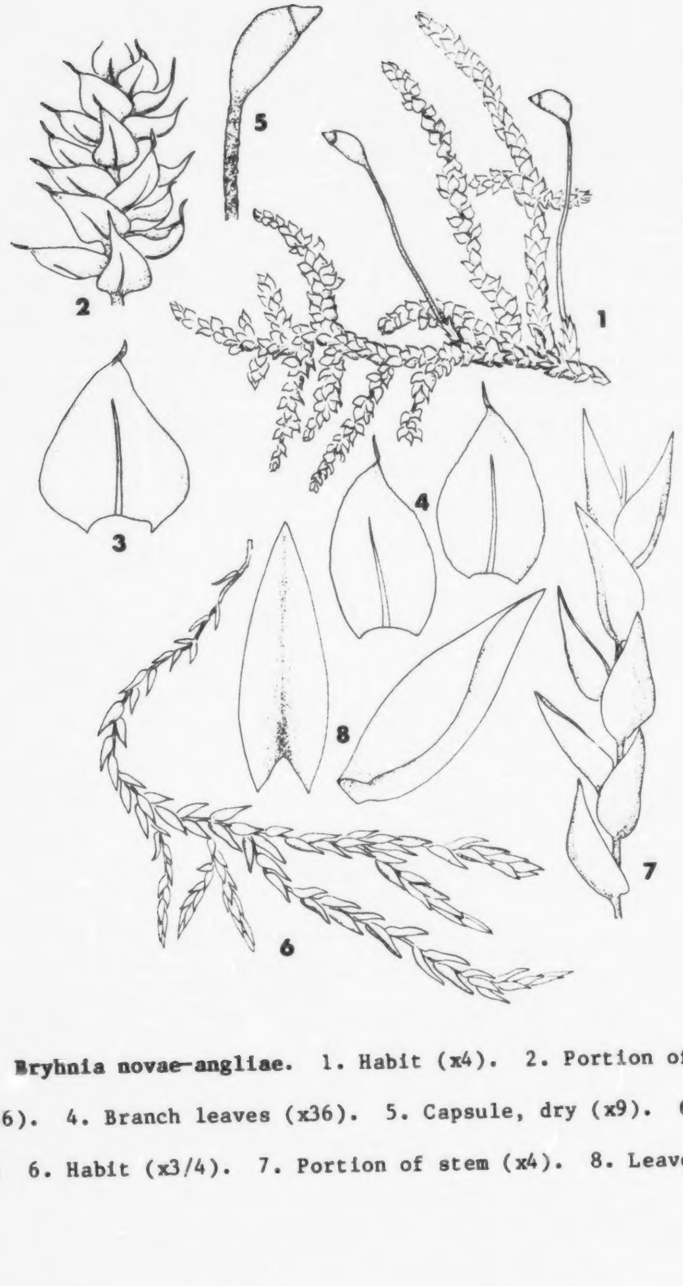

FIGURE 103. 1-5, **Bryhnia novae-angliae.** 1. Habit (x4). 2. Portion of stem (x18). 3. Stem leaf (x36). 4. Branch leaves (x36). 5. Capsule, dry (x9). 6-8, **Fontinalis antipyretica.** 6. Habit (x3/4). 7. Portion of stem (x4). 8. Leaves (x9).

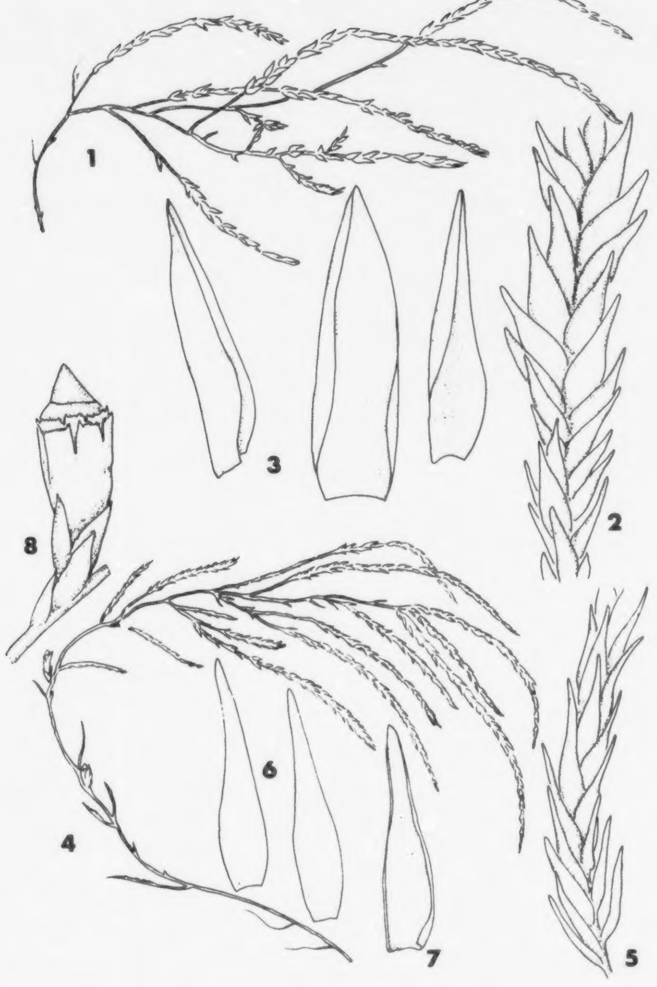

FIGURE 104. 1-3, **Fontinalis novae-angliae.** 1. Habit (x3/4). 2. Portion of stem (x9). 3. Leaves (x18). 4-8, **Fontinalis dalecarlica.** 4. Habit (x3/4). 5. Portion of stem (x9). 6. Leaves, wet (x18). 7. Leaf showing reflexed margins, dry (x18). 8. Capsule, wet (x9).

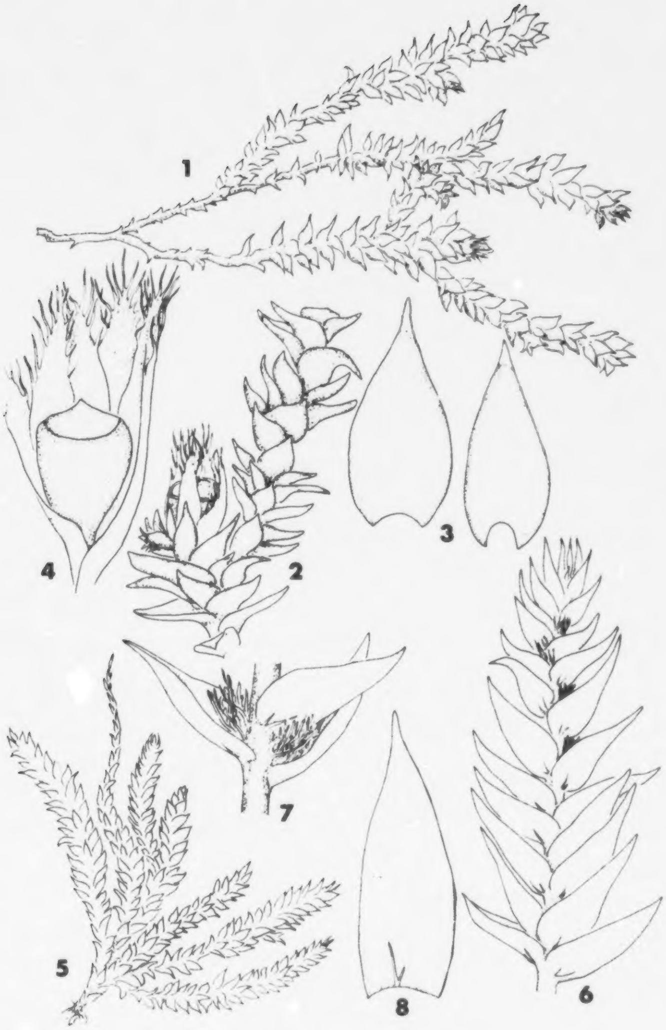

FIGURE 105. 1-4, **Hedwigia ciliata.** 1. Habit (x4). 2. Portion of stem showing capsule (x9). 3. Leaves (x18). 4. Operculate capsule and perichaetial leaves (x18). 5-8, **Isopterygium elegans.** 5. Habit (x4). 6. Portion of stem apex (x18). 7. Portion of stem with microphyllous branchlets (x36). 8. Leaf (x36).

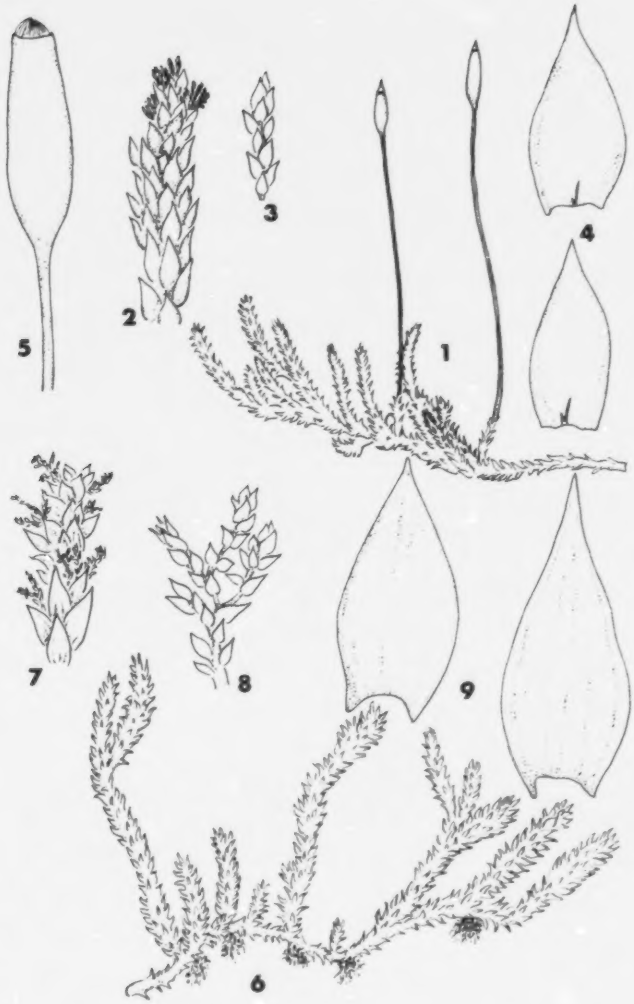

FIGURE 106. 1-5, **Platygyrium repens.** 1. Habit (x4). 2. Branch apex with microphyllous branchlets (x18). 3. Microphyllous branchlet (x36). 4. Leaves (x36). 5. Capsule, dry (x18). 6-9, **Leucodon brachypus** var. **andrewsianus.** 6. Habit (x4). 7. Branch apex with microphyllous branchlets (x9). 8. Microphyllous branchlet (x36). 9. Leaves (x36).

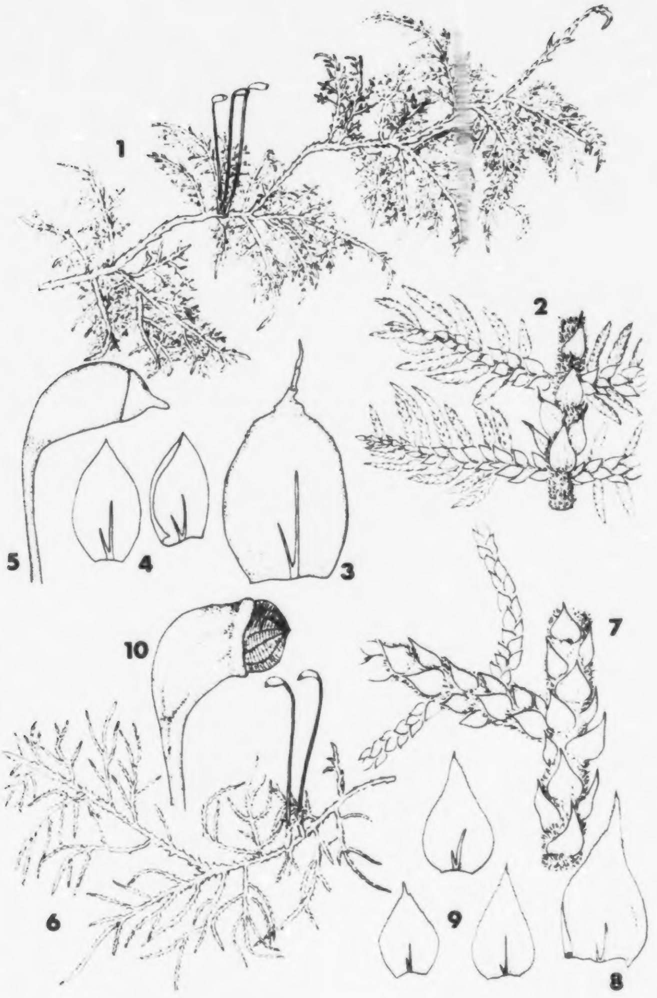

FIGURE 107. 1-5, **Hylocomium splendens**. 1. Habit (x1). 2. Portion of stem showing leaves, paraphyllia and branches (x9). 3. Stem leaf (x18). 4. Branch leaves (x18). 5. Capsule, wet (x18). 6-10, **Hylocomium umbratum**. 6. Habit (x1). 7. Portion of stem showing leaves, paraphyllia and branches (x9). 8. Stem leaf (x18). 9. Branch leaves (x18). 10. Capsule, dry (x18).

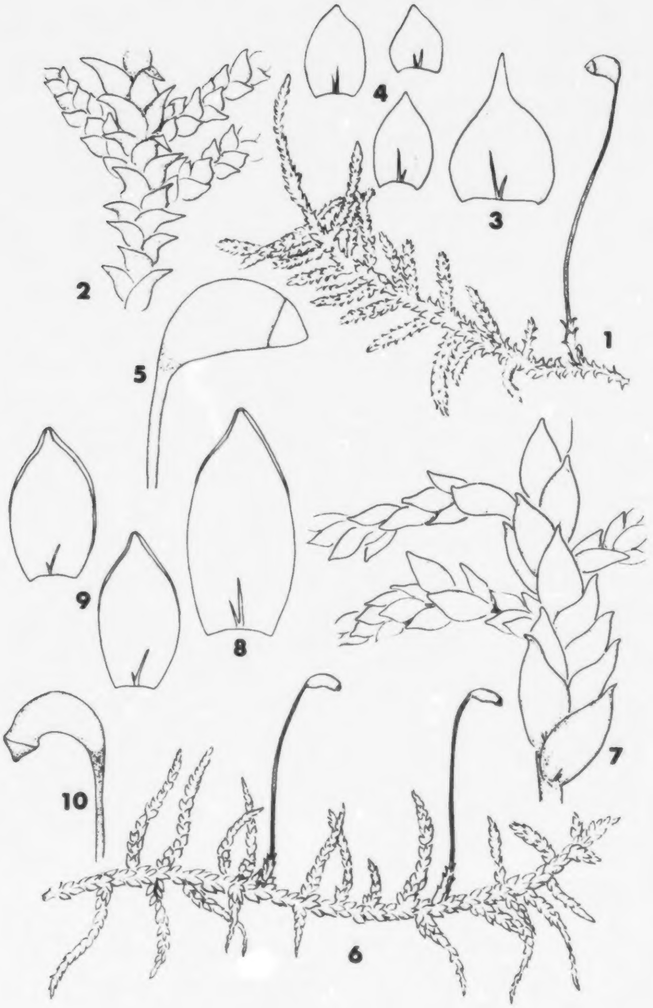

FIGURE 108. 1-5, **Heterocladium dimorphum**. 1. Habit (x4). 2. Portion of stem and branches (x18). 3. Stem leaf (x36). 4. Branch leaves (x36). 5. Capsule (x18). 6-10, **Pleurozium schreberi**. 6. Habit (x1). 7. Portion of stem and branches (x9). 8. Stem leaf (x18). 9. Branch leaves (x18). 10. Capsule (x9).

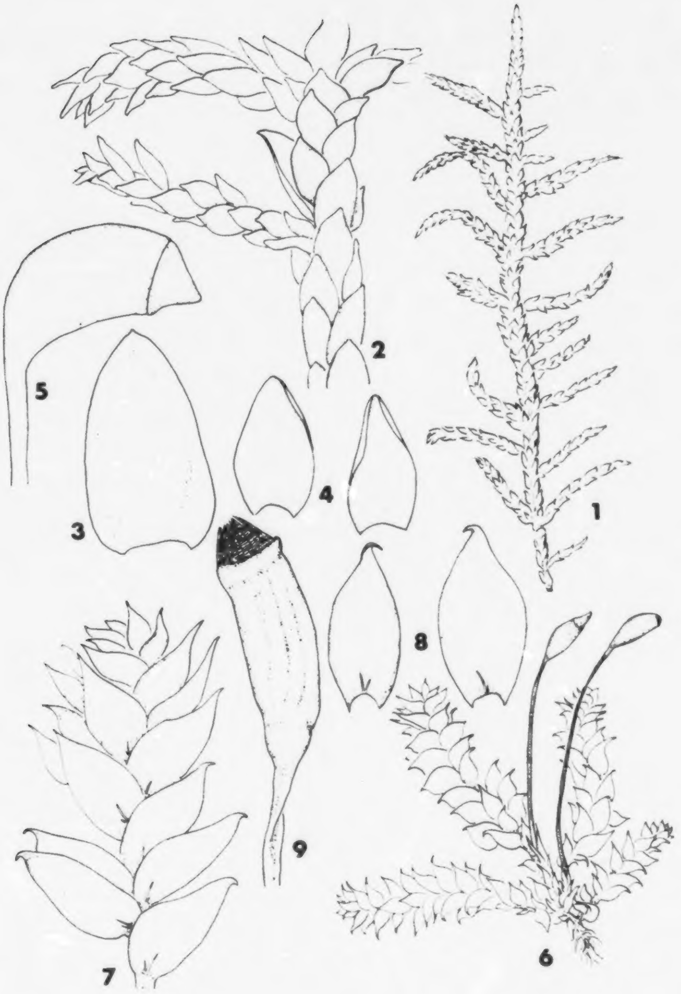

FIGURE 109. 1-5, **Calliergonella cuspidata.** 1. Habit (x2). 2. Portion of stem and branches (x9). 3. Stem leaf (x18). 4. Branch leaves (x18). 5. Capsule, wet (x9). 6-9, **Plagiothecium cavifolium.** 6. Habit (x4). 7. Portion of stem (x18). 8. Leaves (x18). 9. Capsule, dry (x18).

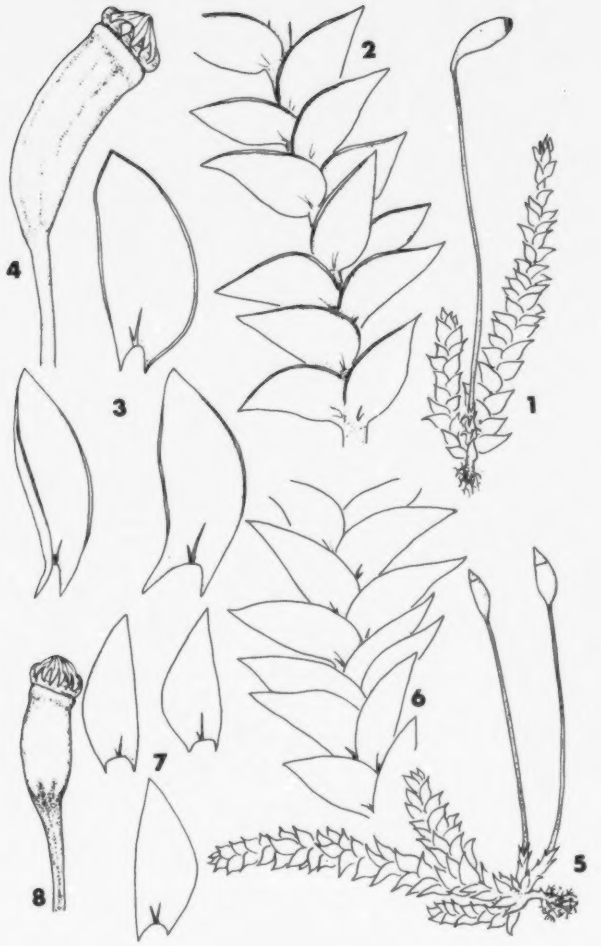

FIGURE 110. 1-4, **Plagiothecium denticulatum.** 1. Habit (x4). 2. Portion of stem (x18). 3. Leaves (x18). 4. Capsule, dry (x18). 5-8, **Plagiothecium laetum.** 5. Habit (x4). 6. Portion of stem (x18). 7. Leaves (x18). 8. Capsule, dry (x18).

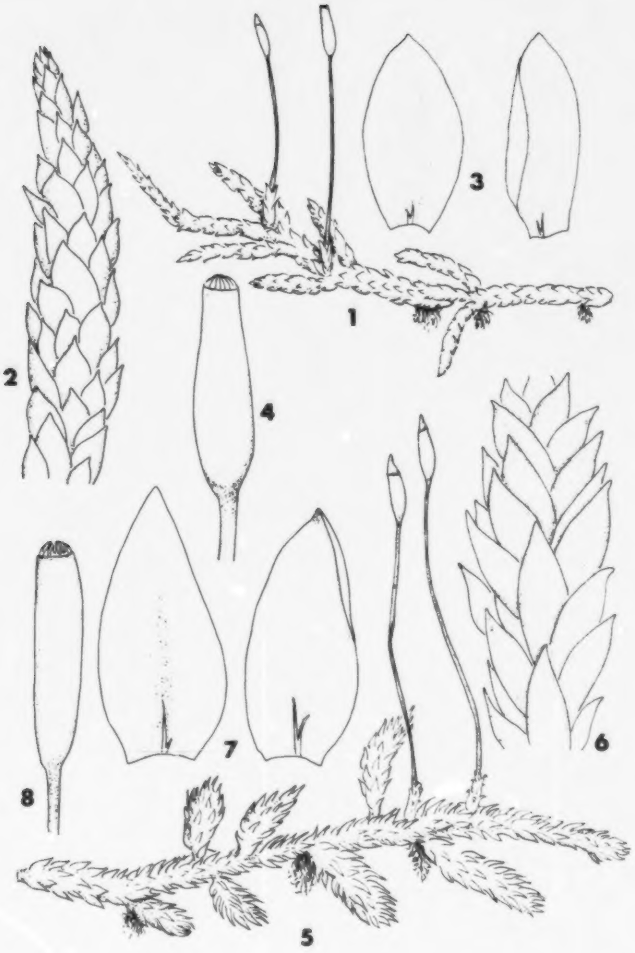

FIGURE 111. 1-4, **Entodon seductrix.** 1. Habit (x4). 2. Portion of stem (x18). 3. Leaves (x36). 4. Capsule (x18). 5-8, **Entodon cladorrhizans.** 5. Habit (x4). 6. Portion of stem (x18). 7. Leaves (x36). 8. Capsule (x18).

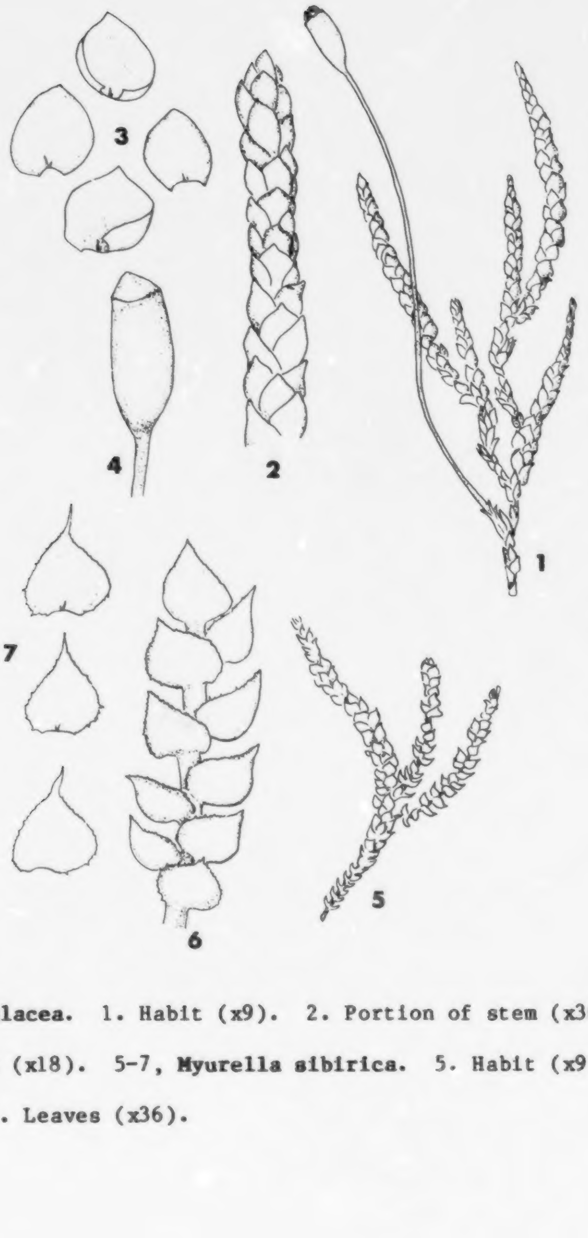

FIGURE 112. 1-4, **Myurella julacea.** 1. Habit (x9). 2. Portion of stem (x36). 3. Leaves (x36). 4. Capsule (x18). 5-7, **Myurella sibirica.** 5. Habit (x9). 6. Portion of stem (x36). 7. Leaves (x36).

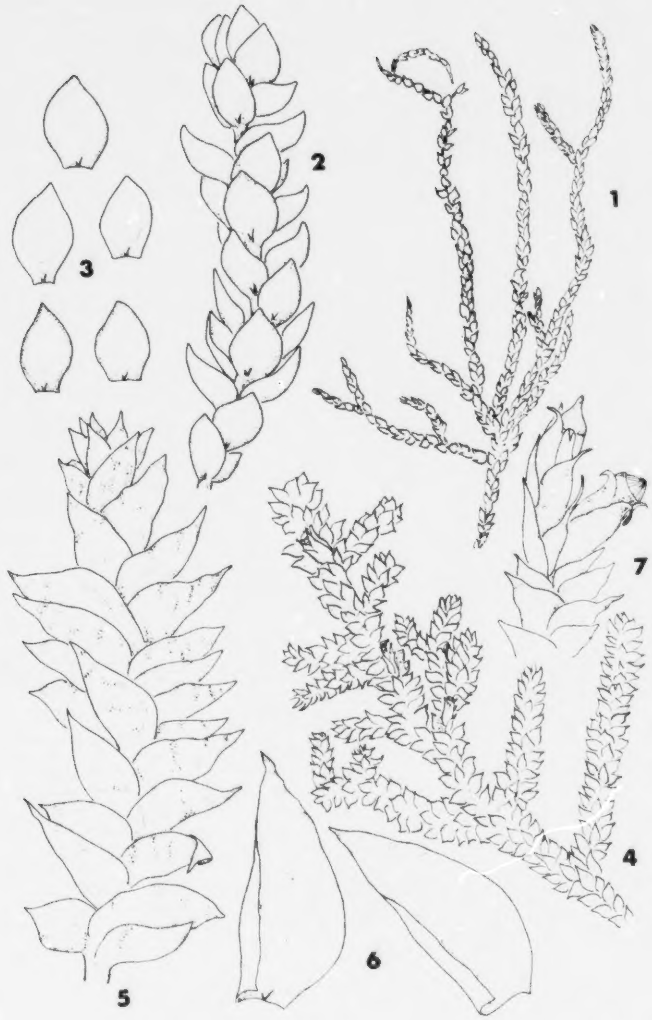

FIGURE 113. 1-3, **Pterigynandrum filiforme.** 1. Habit (x9). 2. Portion of stem (x36). 3. Leaves (x36). 4-7, **Neckera pennata.** 4. Habit (x4). 5. Portion of stem (x18). 6. Leaves (x36). 7. Capsules, operculate and inoperculate (x9).

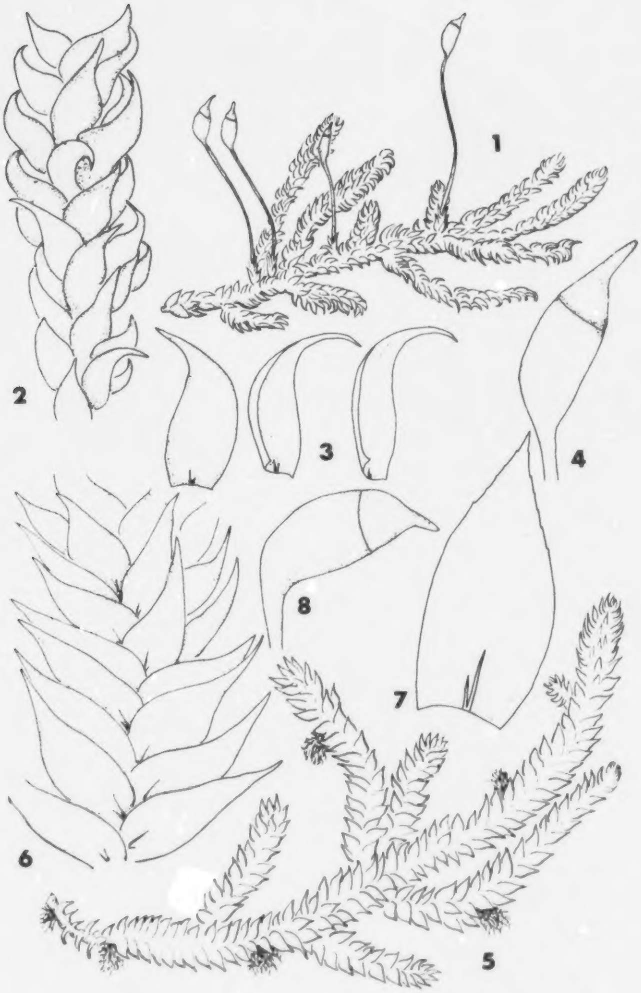

FIGURE 114. 1-4, **Pylaisiadelpha recurvans.** 1. Habit (x4). 2. Portion of stem (x18). 3. Leaves (x36). 4. Capsule (x18). 5-8, **Taxiphyllum deplanatum.** 5. Habit (x4). 6. Portion of stem (x18). 7. Leaf (x18). 8. Capsule (x18).

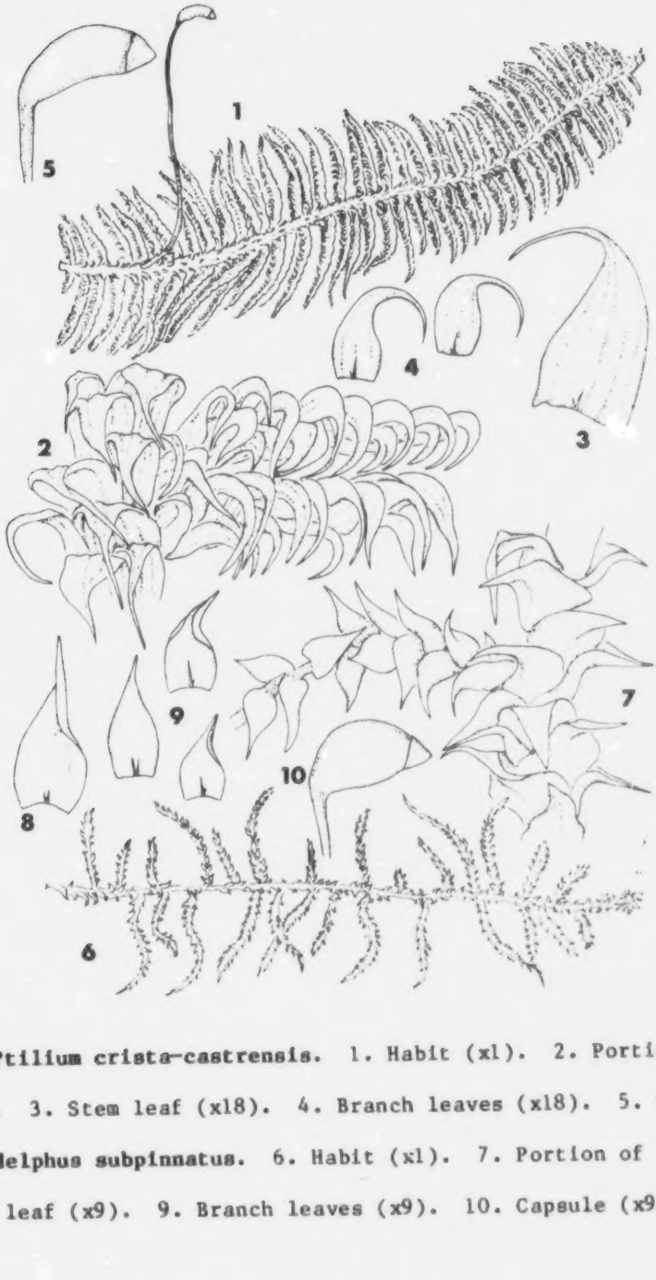

FIGURE 115. 1-5, **Ptilium crista-castrensis.** 1. Habit (x1). 2. Portion of stem and branches (x18). 3. Stem leaf (x18). 4. Branch leaves (x18). 5. Capsule (x4). 6-10, **Rhytidiadelphus subpinnatus.** 6. Habit (x1). 7. Portion of stem and branches (x9). 8. Stem leaf (x9). 9. Branch leaves (x9). 10. Capsule (x9).

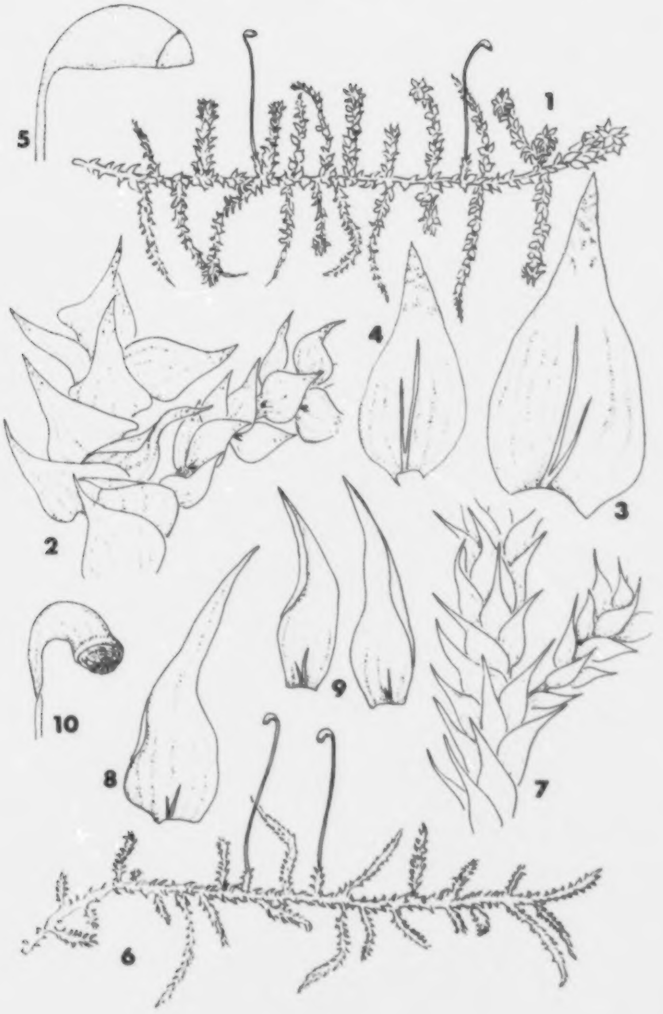

FIGURE 116. 1-5, **Rhytidiadelphus triquetrus**. 1. Habit (x1). 2. Portion of stem and branch (x9). 3. Stem leaf (x18). 4. Branch leaf (x18). 5. Capsule, wet (x9). 6-10, **Rhytidiadelphus loreus**. 6. Habit (x1). 7. Portion of stem and branch (x9). 8. Stem leaf (x18). 9. Branch leaves (x18). 10. Capsule, dry (x9).

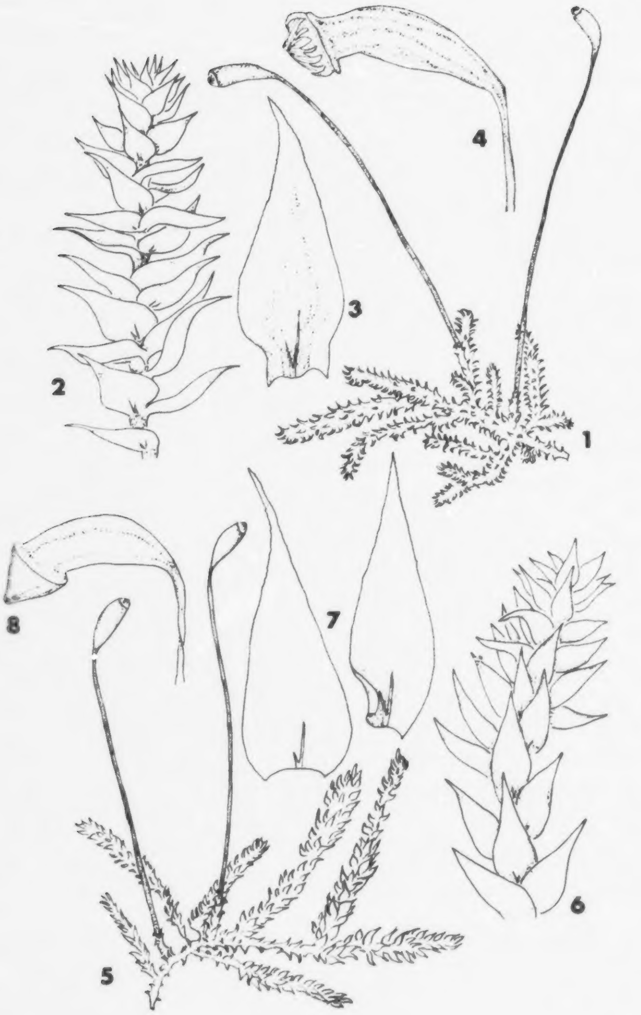

FIGURE 117. 1-4, **Herzogiella striatella.** 1. Habit (x4). 2. Portion of stem (x18). 3. Leaf (x36). 4. Capsule, dry (x18). 5-8, **Herzogiella turfacea.** 5. Habit (x4). 6. Portion of stem (x18). 7. Leaves (x36). 8. Capsule, dry (x18).

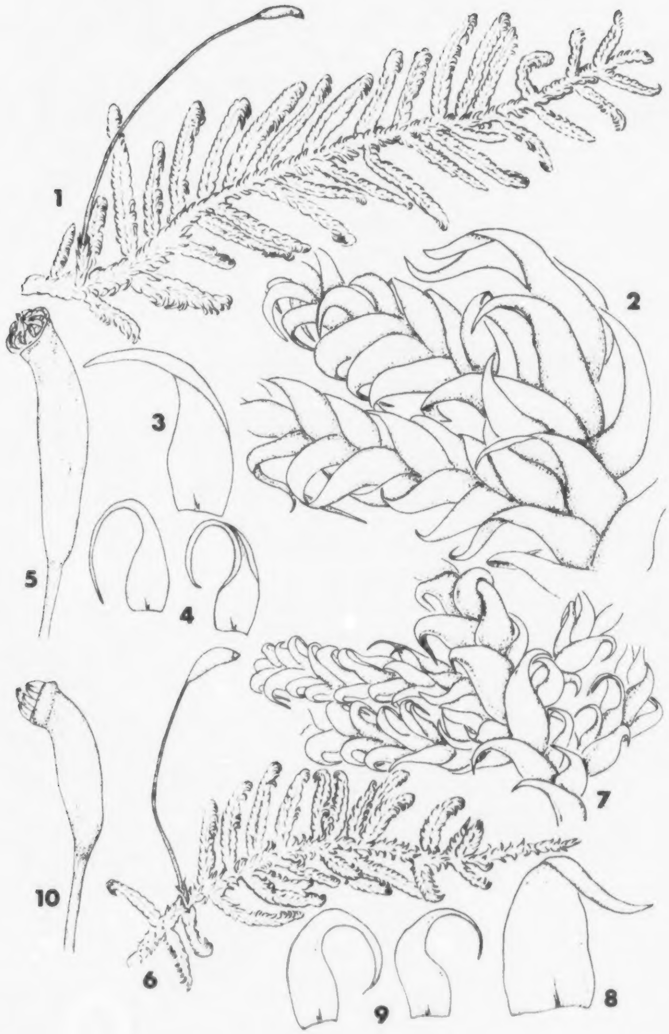

FIGURE 118. 1-5, **Hypnum imponens**. 1. Habit (x2). 2. Portion of stem and branches (x18). 3. Stem leaf (x18). 4. Branch leaves (x18). 5. Capsule, dry (x18). 6-10, **Hypnum pallescens**. 6. Habit (x4). 7. Portion of stem and branches (x18). 8. Stem leaf (x36). 9. Branch leaves (x36). 10. Capsule, dry (x18).

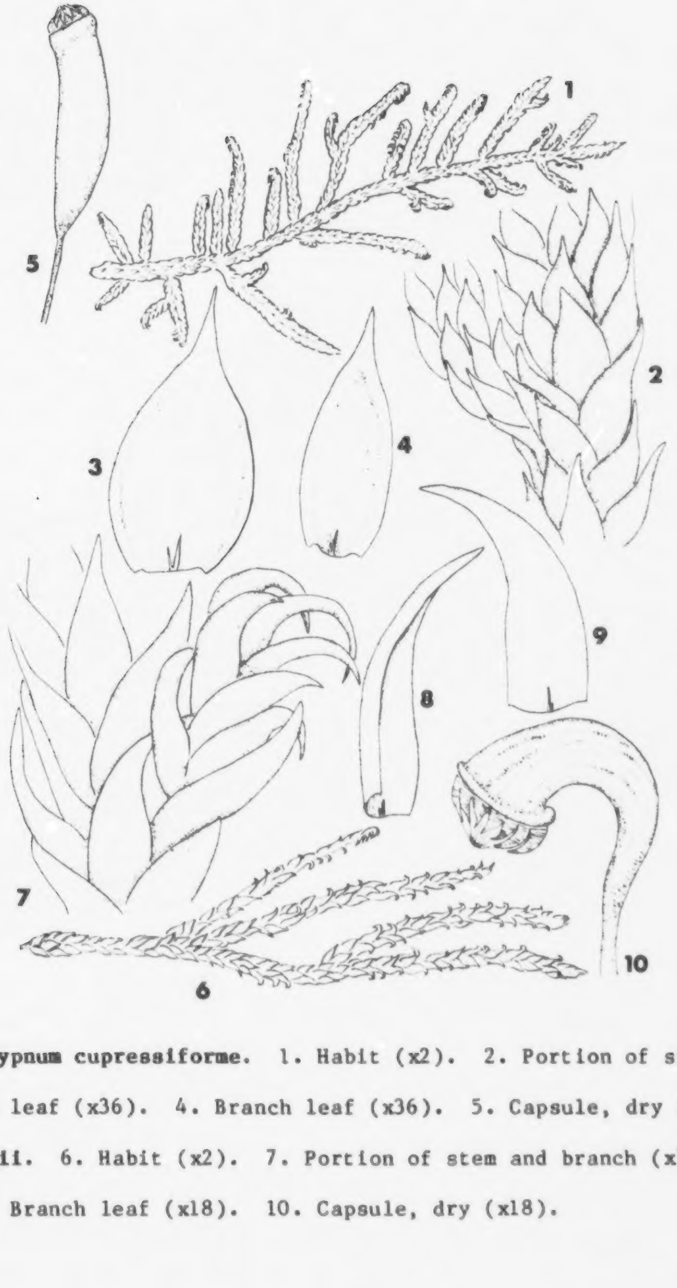

FIGURE 119. 1-5, **Hypnum cupressiforme.** 1. Habit (x2). 2. Portion of stem and branch (x18). 3. Stem leaf (x36). 4. Branch leaf (x36). 5. Capsule, dry (x18). 6-10, **Hypnum lindbergii.** 6. Habit (x2). 7. Portion of stem and branch (x18). 8. Stem leaf (x18). 9. Branch leaf (x18). 10. Capsule, dry (x18).

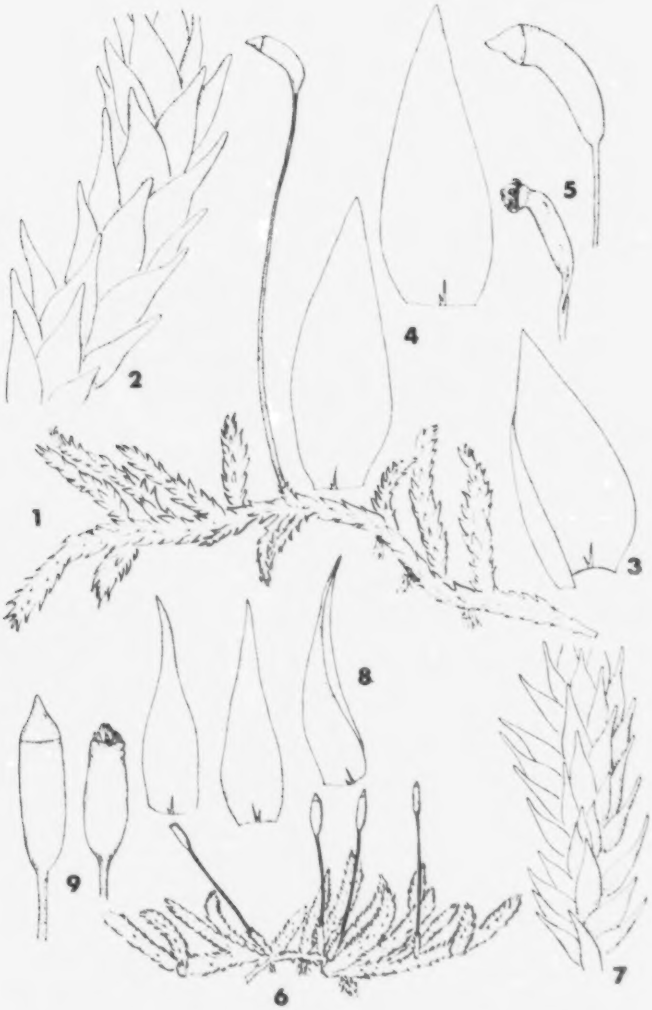

FIGURE 120. 1-5, **Callicaldium haldanianum.** 1. Habit (x4). 2. Portion of branch (x18). 3. Stem leaf (x36). 4. Branch leaves (x36). 5. Capsules, operculate (wet) and inoperculate (dry) (x9). 6-9, **Pylaisiella polyantha.** 6. Habit (x4). 7. Portion of branch (x18). 8. Branch leaves (x36). 9. Capsules, operculate (wet) and inoperculate (dry) (x18).

GLOSSARY

Acrocarpous -- mosses possessing erect, simple or sparsely branched gametophytes that grow in tufts and produce sporophytes at the end of a stem or main branch (e.g., Tetraphis).

Acumen -- a slender, tapering point.

Acuminate -- slenderly tapered. (Fig. 121: 1)

Acute -- sharply pointed (less than 90°). (Fig. 121: 2)

Alar Cells -- cells at the basal angles of a leaf, often differentiated in shape, size or colour. (Fig. 121: 18)

Amphigastria -- a row of rudimentary leaves on the ventral side of the stem; underleaves. (Fig. 128: 100)

Annulus -- a ring of differentiated cells between the mouth of the capsule and the operculum, aiding in dehiscence. (Fig. 126: 73)

Antheridium (pl. Antheridia) -- the male reproductive organ, a globose to cylindric, stalked structure producing sperms. (Fig. 126: 70)

Antheridiophore -- the elevated male structure of certain thalloid liverworts, consisting of a disk and stalk arising from the thallus. (Fig. 127: 90)

Apiculate -- abruptly short-pointed. (Fig. 121: 4)

Apiculus -- a short, abrupt point. (Fig. 121: 4)

Appressed -- lying close together; closely applied to the stem. (Fig. 124: 50)

Archegonium (pl. Archegonia) -- the female reproductive organ, a flask-shaped structure producing an egg. (Fig. 126: 72)

Archegoniophore -- the elevated female structure of certain thalloid liverworts, bearing groups of archegonia. (Fig. 127: 91)

Arcuate -- curved like a bow. (Fig. 126: 78)

Asexual -- involving no sexual action; also possessing neither male nor female organs.

Asymmetric -- not symmetrical.

Attenuate -- narrowly tapered. (Fig. 124: 49)

Auriculate -- with small, ear-like bulges or lobes (auricles) at the basal margins of a leaf. (Fig. 121: 19)

Awn -- a bristle- or hair-point, usually formed by an excurrent costa. (Fig. 121: 3)

Axil -- the upper angle between leaf and stem. (Fig. 122: 26)

Bi- -- a prefix meaning two.

Biflagellate -- with two flagella.

Bilobed -- with two lobes. (Fig. 129: 104)

Bipinnate -- twice-pinnately branched. (Fig. 124: 56)

Bisexual -- having both sexes present.

Border -- margin differentiated from the rest of the leaf in colour or thickness. (Fig. 121: 22)

Bracts -- modified leaves around the reproductive organs; in liverworts, often larger, below the perianth. (Fig. 129: 113)

Bulbiform -- bulb-shaped. (Fig. 124: 57)

Caducous -- deciduous, regularly falling off.

Calcareous -- containing calcium carbonate (e.g., limestone or dolomite rocks).

Calyptra (pl. Calyptrae) -- a membranous hood over the young sporophyte, developed from tissue at the base of the archegonium; in mosses ruptured near the base, carried upward by elongation of the seta, and continuing growth to form a cap over the capsule (Fig. 126: 75-77); in liverworts splitting at elongation of the sporophyte and remaining at its base. (Fig. 129: 113)

Capsule -- the spore case; in mosses often differentiated into an upper spore-bearing urn and a sterile basal portion called the neck (Fig. 126: 73), undifferentiated in hornworts (Fig. 127: 94) and liverworts (Fig. 129: 113).

Cilia (sing. Cilium) -- delicate, hair-like appendages fringing leaves. (Fig. 121: 23)

Ciliate -- fringed with hairy appendages (cilia). (Fig. 121: 23)

Columella -- the central axis of a capsule around which the spores develop. (Fig. 127: 94).

Complanate -- flattened together or compressed in one plane. (Fig. 125: 61)

Complicate-Bilobed -- leaves bilobed, with lobes folded together. (Fig. 129: 109)

Connivent -- with the tips converging, or coming close together. (Fig. 129: 106)

Contorted -- bent into irregular curves, irregularly twisted. (Fig. 122: 32)

Cordate -- heart-shaped. (fig. 121: 12)

Costa (pl. Costae) -- a thickened region of usually elongate cells, either single or double in mosses, single in some thalloid liverworts; midrib. (Fig. 121: 22)

Costate -- with a costa.

Crisped -- irregularly curled and twisted. (Fig. 122: 32)

Cucullate -- hooded or hood-shaped; a cucullate calyptra is conic and split up one side, resembling a monk's hood (Fig. 126: 75); also used to describe leaves concave at the tips. (Fig. 121: 11)

Decurrent -- with the margins extending down the stem below the leaf insertion as ridges or narrow wings. (Fig. 122: 27)

Dendroid -- branched above a trunk-like base and resembling a tree. (Fig. 124: 58)

Dentate -- with sharp teeth directed outward. (Fig. 123: 40)

Dichotomous -- equally forked, with paired branches. (Fig. 124: 60)

Distichous -- in two opposite rows. (Fig. 124: 54)

Dorsal -- the back or lower surface (i.e., the surface away from the stem) or the upper surface (i.e., the surface away from the substratum) of a flattened plant body like a thallus. (Fig. 122: 26; 128: 96, 101)

Dorsal Lobe -- the lobe on the upper surface of a plant. (Fig. 129: 109)

Doubly Serrate -- with teeth overlapping and joined in pairs. (Fig. 123: 42)

E- -- a prefix, meaning not, without.

Ecostate -- without a costa. (Fig. 121: 23)

Elaters -- small, unicellular, sterile cells, usually elongated and with spiral thickenings, mixed with the spores in the capsules of liverworts; aiding in spore dispersal. (Fig. 129: 107)

Elliptic -- essentially oblong but convex at sides and ends. (Fig. 121: 20)

Entire -- not at all indented or toothed; with a continuous margin. (Fig. 123: 39)

Eperistomate -- without a peristome.

Erect-Spreading -- spreading at an angle of about 45° or less. (Fig. 123: 44)

Excurrent -- extending beyond the apex or end of lamina. (Fig. 121: 3)

Exserted -- projecting and exposed, applied to capsules which project beyond the tips of the leaves. (Fig. 127: 88)

Falcate -- curved like the blade of a sickle. (Fig. 122: 34)

Falcate-Secund -- strongly curved and turned to one side. (Fig. 124: 53)

Fascicle -- a small bundle or cluster. (Fig. 125: 64)

Female Bracts -- modified leaves, often larger, below the perianth; also called perichaetial bracts. (Fig. 129: 113)

Filiform -- slender and elongate, filamentous, thread-like.

Flagella (sing. Flagellum) -- whip-like slender branches or stems, leafless or with rudimentary leaves, e.g., Bazzania (Fig. 128: 100); long, whip-like structures controlling the movement of the sperm cell.

Flexuose -- slightly and irregularly bent, twisted, or wavy. (Fig. 122: 33)

Foot -- the basal absorbing organ of the sporophyte. (Fig. 126: 73)

Frondose -- closely and regularly branched in one plane.

Gametophyte -- the dominant, sexual generation which bears the sex organs; the green, leafy or thalloid plant. (Fig. 128: 95-96)

Gemma (pl. Gemmae) -- a small, asexually produced reproductive body, formed of 1-several cells. (Fig. 125: 66; 129: 112)

Gemmae Cup -- small cup-like structure, formed from modified leaves, leafy tissue or thalloid tissue, that contains gemmae. (Fig. 125: 65; 128: 97)

Gemmae Receptacle -- a container with gemmae inside. (Fig. 128: 98)

Gemmiferous -- bearing gemmae.

Globose -- spherical. (Fig. 126: 83)

Hispid -- with short, stiff hairs, bristly. (Fig. 126: 76)

Hyaline -- colourless and transparent.

Hygrophytic -- indicating a plant occurring in wet habitats but not in water.

Imbricate -- closely overlapping. (Fig. 124: 51)

Immersed -- completely covered; immersed capsules are exceeded by the tips of leaves. (Fig. 127: 89)

Inclined Capsule -- less than vertical, between erect and horizontal. (Fig. 126: 79)

Incubous -- leaves of liverworts that are obliquely inserted so the lower leaf overlaps the one above it when viewed from the dorsal surface and toward the stem apex. (Fig. 128: 101)

Inflated -- swollen.

Inflorescence -- a cluster of sex organs and the leaves surrounding them.

Inoperculate -- without operculum.

Involucre -- a short tube or sheath, sometimes formed by an outgrowth of the thallus, forming a protective covering around the archegonia and sporophyte. (Fig. 129: 113)

Julaceous -- smoothly cylindric, like a worm, referring to stems or branches with crowded and imbricate leaves. (Fig. 124: 52)

Keel -- the projecting ridge on the fold of some leaves. (Fig. 122: 29; 129: 109)

Lamellae (sing. Lamella) -- ridges or plates on the costa or lamina of some moss leaves. (Fig. 122: 38)

Lamina (pl. Laminae) -- the expanded part of a leaf or thallus (as distinguished from the costa). (Fig. 121: 22)

Lanceolate -- lance-shaped, narrow and tapered from the base (narrower than ovate). Fig. 121: 16)

Lateral -- on or at the side.

Ligulate -- strap-shaped (longer and narrower than lingulate). (Fig. 121: 13)

Linear -- very narrow and elongate, with nearly parallel sides (narrower than ligulate). (Fig. 121: 14)

Lingulate -- tongue-shaped, oblong with a broadened apex. (Fig. 121. 15)

Mesic -- moist, neither very wet nor very dry but intermediate.

Micrometer -- one-thousandth of a millimeter.

Microphyllous Branchlets -- small branches with reduced leaves, serving as asexual reproductive bodies. (Fig. 125: 67)

Mitrate -- conic and undivided or equally lobed at base, referring to calyptrae of mosses (opposed to cucullate or split on one side). (Fig. 126: 77)

Mucro -- a short, abrupt point. (Fig. 121: 6)

Mucronate -- ending abruptly in a short point usually caused by a shortly excurrent costa. (Fig. 121: 6)

Multicellular -- composed of more than one cell.

Multistratose -- composed of more than one layer.

Neck -- the sterile basal portion of a capsule, sometimes considerably differentiated. (Fig. 126: 73)

Oblong -- much longer than broad, with nearly parallel sides. (Fig. 121: 24)

Obovate -- egg-shaped, with the broader portion at the apex rather than the base; the reverse of ovate. (Fig. 121: 25)

Obtuse -- blunt or rounded. (Fig. 121: 8)

Ocelli -- modified leaf cells in some liverworts, often glistening or discoloured, sometimes in groups or lines. (Fig. 129: 110)

Operculate -- with operculum.

Operculum (pl. Opercula) -- the lid covering the mouth of a moss capsule, falling at maturity to release the spores. (Fig. 126: 73)

Oval -- broadly elliptic in outline. (Fig. 121: 17)

Ovate -- egg-shaped in outline (with the base broader than the apex). (Fig. 121: 21)

Ovoid -- an egg-shaped solid. (Fig. 126: 82)

Paraphyllia (sing. Paraphyllium) -- small, filiform, lanceolate, or leaf-like, sometimes branched structures, with a white, yellow, green or rarely brown colour and often cobwebby appearance on stems and branches of some mosses. (Fig. 125: 68)

Paraphyses (sing. Paraphysis) -- hyaline or yellowish, multicellular hairs, sometimes club-shaped, mingled with the antheridia (and often with archegonia). (Fig. 126: 71)

Pendulous -- somewhat drooping, more inclined than horizontal. (Fig. 126: 80)

Percurrent -- extending to the apex. (Fig. 121: 5)

Perianth -- a tubular sheath formed of 2-3 leaves that surrounds the archegonia and sporophyte. (Fig. 129: 113)

Perichaetia (sing. Perichaetium) -- female inflorescences, comprised of leaves surrounding the archegonia.

Perichaetial Leaves -- the leaves surrounding the archegonia.

Peristome -- a single or double circle of teeth inside the mouth of the capsule of mosses; aiding in spore dispersal. (Fig. 126: 74)

Peristomate -- with a peristome.

Pinnate -- with numerous, spreading branches on two sides of the axis and thus resembling a feather. (Fig. 124: 55)

Plane -- flat.

Pleurocarpous -- mosses possessing prostrate, freely branched gametophytes that grow in mats and produce sporophytes laterally from the main stem (e.g., Hylocomium).

Plicate -- folded in longitudinal pleats. (Fig. 122: 35)

Plumose -- closely and regularly pinnate, feathery. (Fig. 125: 62)

Postical -- below or behind; pertaining to the under (rhizoid-bearing) surface of a stem or the lower margin of a leaf.

Primary Stem -- the main stem, often creeping or rhizome-like with reduced or scale-like leaves.

Prostrate -- creeping.

Protonema (pl. Protonemata) -- green, branched filaments produced on germination of spores and giving rise to a leafy or thallose gametophyte.

Pseudoelaters -- small, 2-5 celled, sterile structures mixed with the spores in the capsules of hornworts; aiding in spore dispersal. (Fig. 129: 108)

Pseudopodium (pl. Pseudopodia) -- an elongation of a stem tip bearing clusters of gemmae. (Fig. 125: 66)

Pyriform -- pear-shaped. (Fig. 126: 81)

Reflexed -- bent backward. (Fig. 122: 31)

Retuse -- slightly indented at a broad apex. (Fig. 121: 9)

Rhizoids -- filamentous, unicellular (hornworts and liverworts) or multicellular (mosses) structures, dead at maturity, occurring on the gametophyte and anchoring it to the substratum. (Fig. 124: 58-59)

Rib -- a longitudinal ridge on capsules or other organs. (Fig. 127: 84)

Rosette -- circular (rose-like) arrangement of leaves. (Fig. 124: 59)

Rugose -- with irregular transverse wrinkles or undulations. (Fig. 122: 36)

Scales -- flat, blade-like, ventral appendages on gametophytes of thalloid liverworts. (Fig. 128: 99)

Secondary Stem -- branches arising from the main or primary stem.

Secund -- turned to one side.

Sessile -- without a stalk or seta.

Serrate -- saw-toothed, with marginal teeth pointing forward. (Fig. 123: 41)

Seta (pl. Setae) -- the stalk supporting the capsule. (Fig. 126: 73; 129: 113)

Sheathing -- surrounding and clasping the stem or base of the seta. (Fig. 122: 28)

Simple -- applied to structures, organs or plants that are unbranched.

Sinus -- the indentation between lobes of a leaf. (Fig. 129: 104)

Spinose -- spiny, with sharp, slender teeth or projections. (Fig. 123: 43)

Spinulose -- minutely spiny.

Spores -- minute, mostly spherical, nearly always unicellular bodies, produced in the capsule, that on germination form a gametophyte.

Sporophyte -- the spore-bearing generation; the spore-bearing plant, produced by the fertilization of an egg, remaining attached to the gametophyte and partially dependent on it, typically consisting of foot, seta and capsule. (Fig. 126: 73)

Spreading -- at an angle of 45° or more. (Fig. 123: 45)

Squarrose -- spreading at right angles. (Fig. 123: 47)

Squarrose-Recurved -- spreading at right angles, with the tips curved downward. (Fig. 123: 48)

Stoloniferous -- plants that bear slender, creeping, usually minutely leaved stems and branches, often with rhizoids near the tips. (Fig. 125: 63)

Striate -- marked with fine, longitudinal ridges. (Fig. 127: 86)

Striolate -- finely ridged.

Struma -- a goiter-like swelling on one side of the base of a capsule of some mosses. (Fig. 127: 87)

Strumose -- bearing a struma. (Fig. 127: 87)

Sub- -- a prefix meaning nearly, almost, somewhat, as in subglobose, subpercurrent, or subpinnate; also used to mean under, as subterranean.

Substratum -- the surface to which the plant is attached.

Subulate -- slenderly long-acuminate, shaped like a needle. (Fig. 121: 7)

Succubous -- leaves of liverworts that are obliquely inserted so the upper leaf overlaps the one below it when viewed from the dorsal surface and toward the stem apex. (Fig. 128: 102)

Sulcate -- grooved or furrowed. (Fig. 127: 85)

Symmetric -- capable of division by one or more planes forming similar halves.

Terete -- rounded in cross-section, cylindric. (Fig. 124: 52)

Thalloid -- of, relating to, resembling or consisting of a thallus.

Thallus (pl. Thalli) -- a plant body that is flat, not much differentiated, and cordate or ribbon-like. (Fig. 128: 96)

Tomentose -- densely woolly, covered with rhizoids. (Fig. 125: 69)

Tooth -- a division of the peristome (Fig. 126: 74); also applied to irregularities or projections at the margins of leaves. (Fig. 123: 43)

Transverse -- leaves of liverworts that are inserted at right angles to the line of the stem. (Fig. 128: 103)

Tri- -- a prefix meaning thrice.

Tridentate -- with three dentations. (Fig. 129: 105)

Truncate -- abruptly cut off or squared off at the apex. (Fig. 121: 10)

Tubulose -- tube-like, usually referring to leaves with strongly incurved margins. (Fig. 122: 30)

Underleaves -- the leaves of the single row on the postical side of the stem of liverworts; amphigastria. (Fig. 128: 100)

Undulate -- wavy. (Fig. 122: 37)

Unicellular -- composed of one cell.

Unistratose -- composed of one layer.

Urn -- the spore bearing portion of a capsule. (Fig. 126: 73)

Valve -- one of the divisions into which the capsule of hornworts, most liverworts and the moss Andreaea separates when the spores are ready to be shed. (Fig. 127:92-94)

Ventral -- the front or upper surface (i.e., the surface toward the stem) of a leaf, or the lower surface (i.e., the surface toward the substratum) of a flattened plant body like a thallus. (Fig. 122: 26; 128: 99-100)

Ventral Lobe -- the lobe on the lower surface of the plant. (Fig. 129: 109)

Vitta -- a central band of one or more rows of glistening, elongated and thickened cells of certain liverworts, e.g., Diplophyllum. (Fig. 129: 111)

Wide-Spreading -- spreading at an angle but less than 90°. (Fig. 123: 46)

Xerophytic -- referring to a plant adapted to a dry habitat.

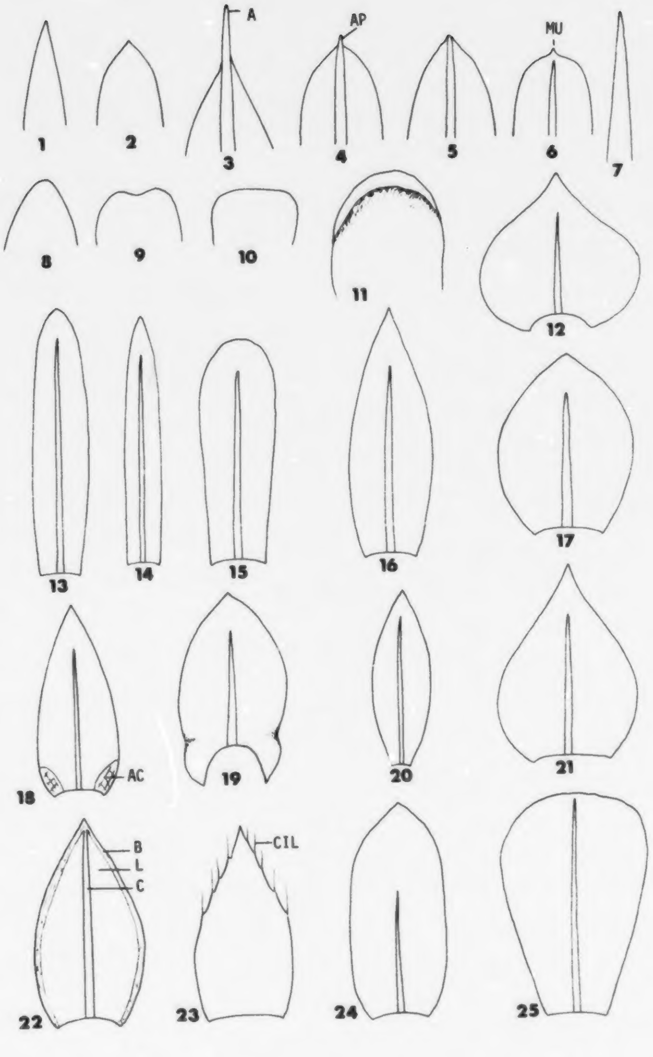
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FIGURE 121. 1. Acuminate. 2. Acute. 3. Excurrent (A - awn). 4. Apiculate (AP - apiculus). 5. Percurrent. 6. Mucronate (MU - mucro). 7. Subulate. 8. Obtuse. 9. Retuse. 10. Truncate. 11. Cucullate. 12. Cordate. 13. Ligulate. 14. Linear. 15. Lingulate. 16. Lanceolate. 17. Oval. 18. Alar cells (AC). 19. Auriculate. 20. Elliptic. 21. Ovate. 22. Border (B - border; C - costa; L - lamina). 23. Ciliate, Ecostate (CIL - cilium). 24. Oblong. 25. Obovate.

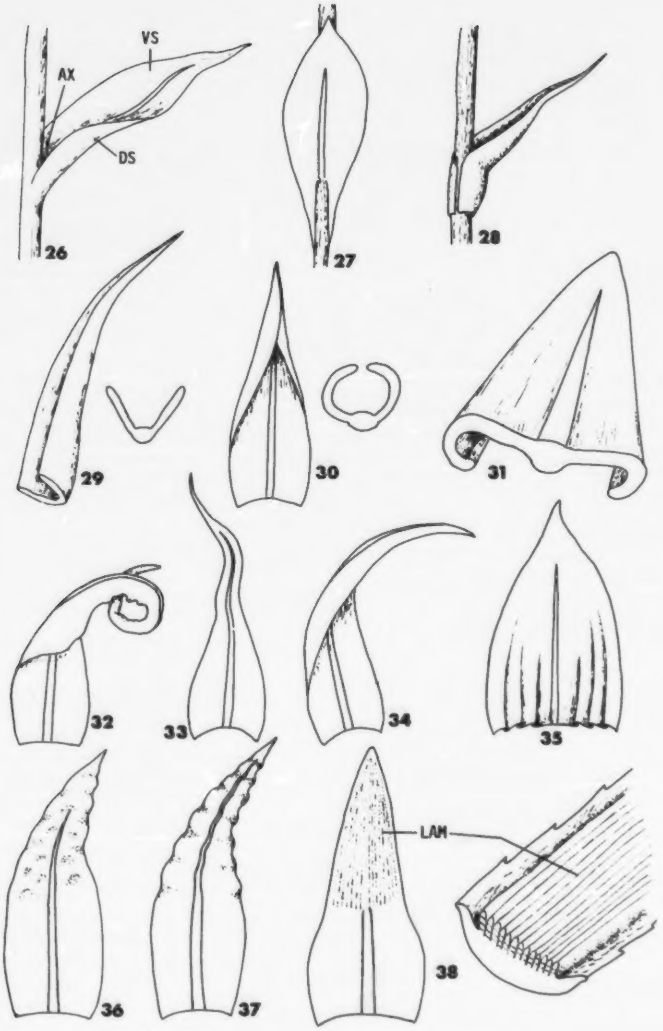
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FIGURE 122. 26. Axil (AX), Ventral (VS) and Dorsal Surfaces (DS). 27. Decurrent. 28. Sheathing. 29. Keel. 30. Tubulose. 31. Reflexed. 32. Contorted, Crisped. 33. Flexuose. 34. Falcate. 35. Plicate. 36. Rugose. 37. Undulate. 38. Lamellae (LAM).

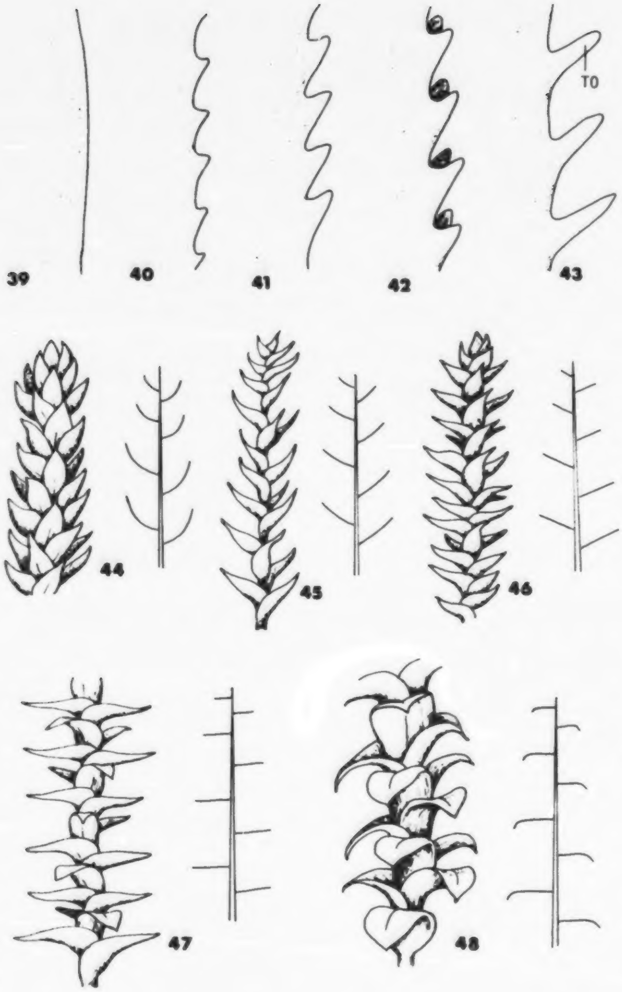
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FIGURE 123. 39-43. Leaf Margins. 39. Entire. 40. Dentate. 41. Serrate. 42. Doubly Serrate. 43. Spinose (TO - tooth). 44. Erect-Spreading. 45. Spreading. 46. Wide-Spreading. 47. Squarrose. 48. Squarrose-Recurved.

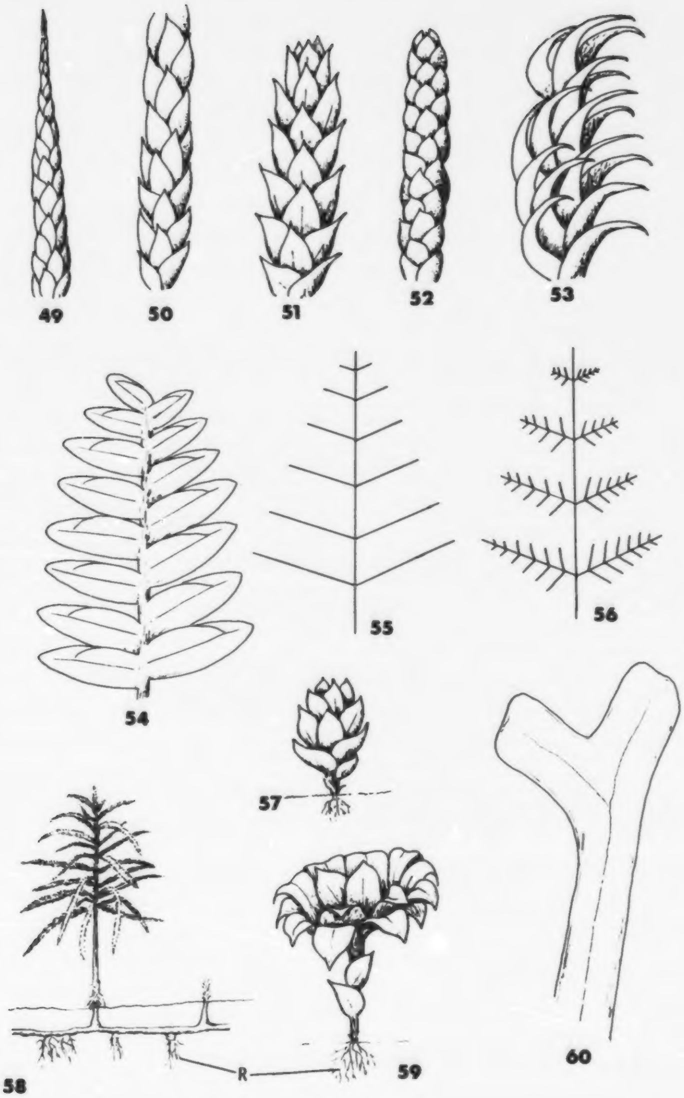
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FIGURE 124. 49. Attenuate. 50. Appressed. 51. Imbricate. 52. Julaceous, Terete. 53. Falcate-Secund. 54. Distichous. 55. Pinnate. 56. Bipinnate. 57. Bulbiform. 58. Dendroid (R - rhizoids). 59. Rosette. 60. Dichotomous.

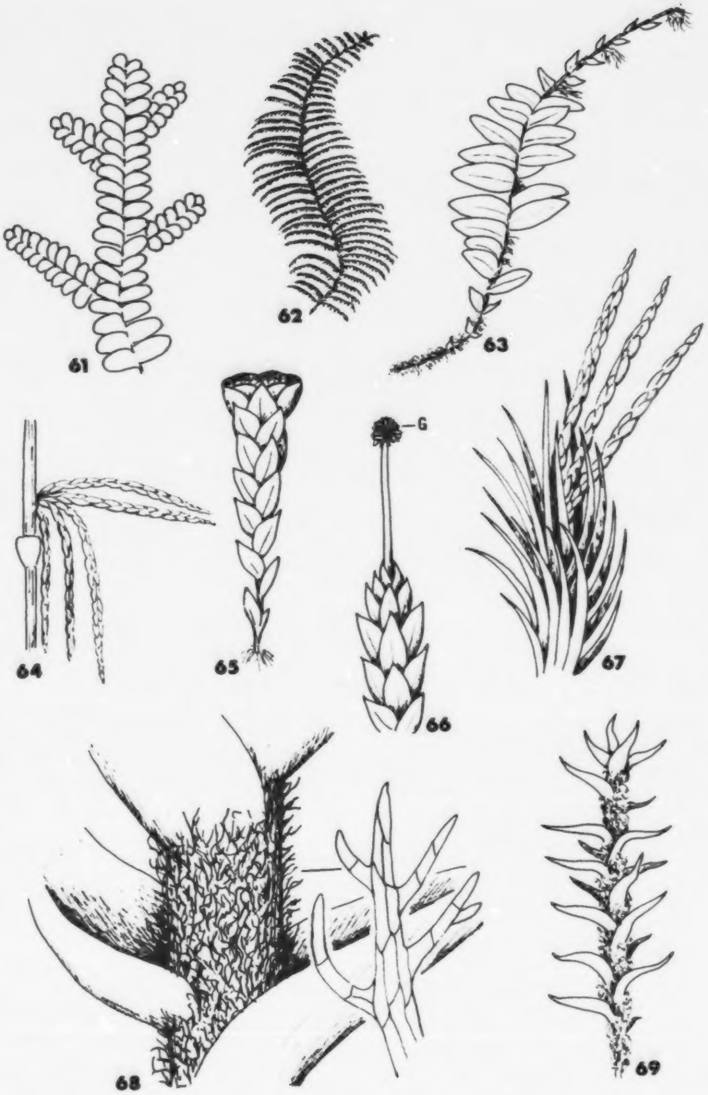
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FIGURE 125. 61. Complanate. 62. Plumose. 63. Stoloniferous. 64. Fascicle. 65. Gemmae Cup. 66. Pseudopodium (G - gemmae). 67. Microphyllous Branchlets. 68. Paraphyllia. 69. Tomentose.

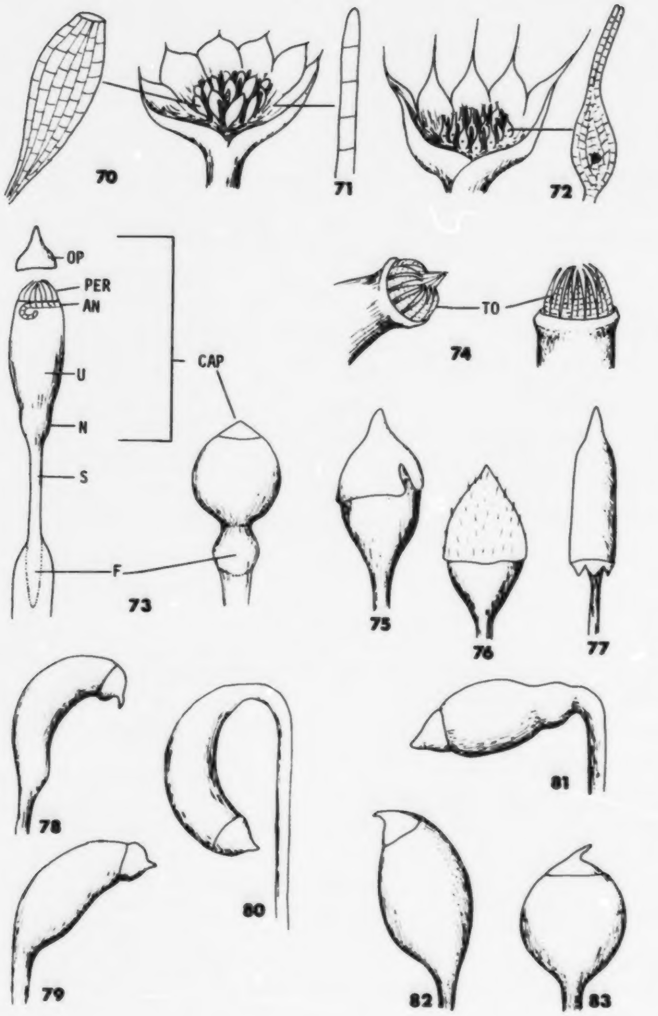
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FIGURE 126. 70. Antheridium. 71. Paraphysis. 72. Archegonium. 73. Sporophyte (AN - annulus; CAP - capsule; F - foot; N - neck; OP - operculum; PER - peristome; S - seta; U - urn). 74. Peristome (TO - tooth). 75-77. Calyptrae. 75. Cucullate. 76. Hispid. 77. Mitrate. 78-83. Capsules. 78. Arcuate. 79. Inclined. 80. Pendulous. 81. Pyriform. 82. Ovoid. 83. Globose.

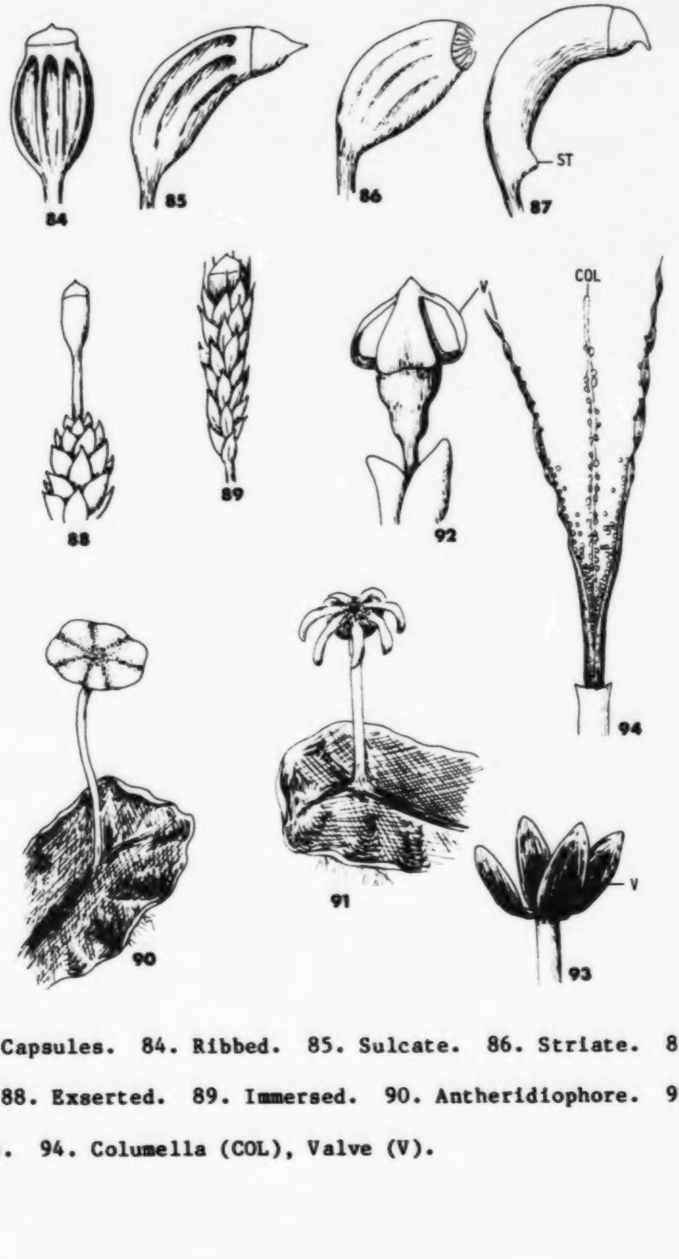
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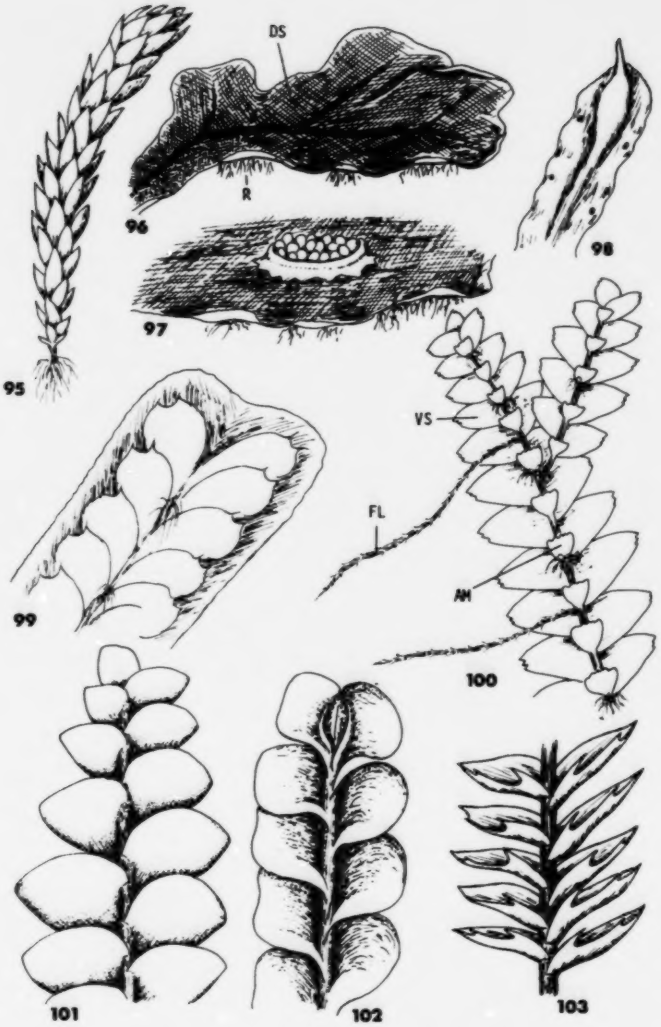
FIGURE 127. 84-87. Capsules. 84. Ribbed. 85. Sulcate. 86. Striate. 87. Strumose (ST - struma). 88. Exserted. 89. Immersed. 90. Antheridiophore. 91. Archegoniophore. 92-93. Valve (V). 94. Columella (COL), Valve (V).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AM
100
101
102
103

FIGURE 128. 95. Leafy Gametophyte. 96. Thalloid Gametophyte (DS - dorsal surface; R - rhizoids). 97. Gemmae Cup. 98. Gemmae Receptacle. 99. Scales on Ventral Surface of Thallus. 100. Amphigastria or Underleaves (AM), Flagella (FL), Ventral Surface (VS). 101. Incubous. 102. Succubous. 103. Transverse.

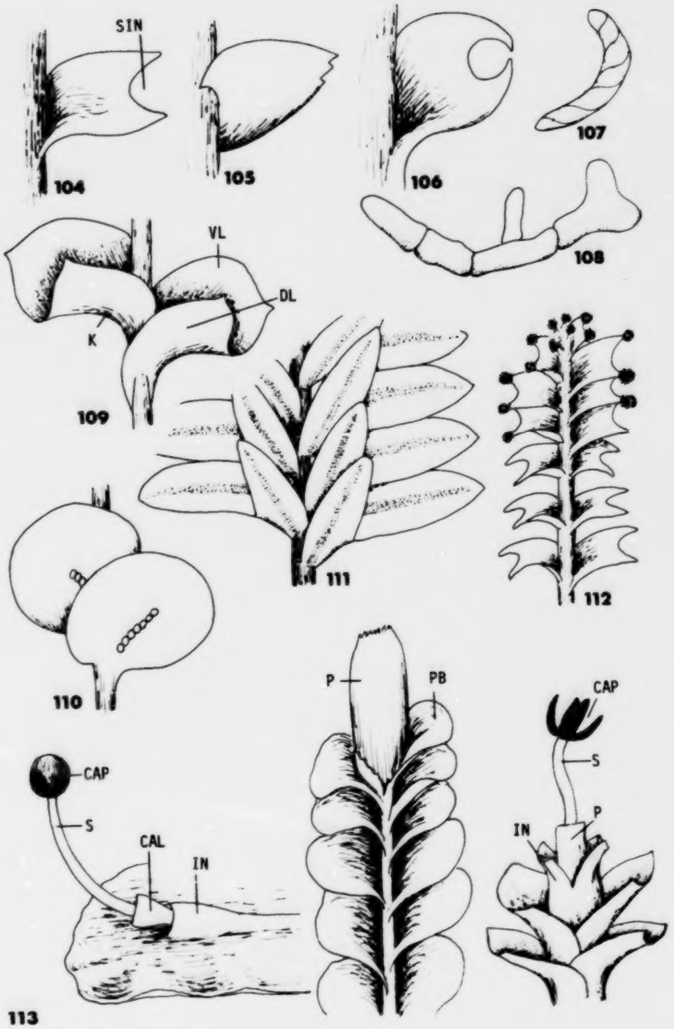
SIN
104
105
106
107
108
VL
DL
K
109
111
112
110
P
PB
CAP
S
P
IN
CAP
S
CAL
IN
113

FIGURE 129. 104. Bilobed, Sinus (SIN). 105. Tridentate. 106. Connivent. 107. Elater. 108. Pseudoelater. 109. Complicate-bilobed, Keel (K), Dorsal (DL) and Ventral Lobes (VL). 110. Ocelli. 111. Vitta. 112. Gemmae. 113. Perianth (P), Perichaetial Bract (PB), Involucre (IN), Seta (S), Capsule (CAP), Calyptra (CAL).

GEOGRAPHIC ABBREVIATIONS

AK - Alaska

AL - Alabama

AR - Arkansas

AT - Alberta

AZ - Arizona

BC - British Columbia

CA - California

CO - Colorado

CT - Connecticut

FL - Florida

GA - Georgia

GR - Greenland

IA - Iowa

ID - Idaho

IL - Illinois

IN - Indiana

KS - Kansas

KY - Kentucky

LA - Louisiana

LB - Labrador

MA - Massachusetts

MB - Manitoba

MD - Maryland

ME - Maine

MI - Michigan

MN - Minnesota

MO - Missouri

MS - Mississippi

MT - Montana

NB - New Brunswick

NC - North Carolina

ND - North Dakota

NE - Nebraska

NF - Newfoundland

NH - New Hampshire

NJ - New Jersey

NM - New Mexico

NS - Nova Scotia

NT - Northwest Territories

NV - Nevada

NY - New York

OH - Ohio

OK - Oklahoma

ON - Ontario

OR - Oregon

PA - Pennsylvania

PE - Prince Edward Island

QU - Quebec

SA - Saskatchewan

SC - South Carolina

SD - South Dakota

TN - Tennessee

TX - Texas

UT - Utah

VA - Virginia

VT - Vermont

WA - Washington

WI - Wisconsin

WV - West Virginia

WY - Wyoming

YT - Yukon Territory

INDEX TO BRYOPHYTES

Page numbers in parentheses refer to illustrations

- Anastrophyllum
  - michauxii 49 (75)
  - minutum 48 (75)
- Andreaea
  - rothii 79 (111)
  - rupestris 79 (111)
- Aneura
  - pinguis 25 (35)
- Anomodon
  - attenuatus 100 (159)
  - rostratus 100 (158)
  - viticulosus 100 (159)
- Anthoceros
  - macounii 21 (22)
- Atrichum
  - altecristatum 81 (115)
  - crispum 80 (115)
  - oerstedianum 81 (116)
- Aulacomnium
  - androgynum 90 (137)
  - palustre 90 (137)
- Barbilophozia
  - attenuata 44 (66)
  - barbata 44 (66)
  - hatcheri 44 (67)
  - lycopodioides 44 (67)
- Barbula
  - convoluta 88 (133)
  - unguiculata 90 (133)
- Bartramia
  - pomiformis 85 (125)
- Bazzania
  - trilobata 42 (63)
- Blasia
  - pusilla 24 (31)
- Blepharostoma
  - trichophyllum 37 (51)
- Blindia
  - acuta 83 (120)
- Brachythecium
  - reflexum 101 (161)
  - rivulare 101 (160)
  - salebrosum 101 (160)
  - velutinum 101 (161)
- Bryhnia
  - novae-angliae 101 (167)
- Bryoerythrophyllum
  - recurvirostrum 94 (147)
- Bryum
  - argenteum 86 (129)
  - pseudotriquetrum 87 (129)
- Buxbaumia
  - aphylla 79 (112)
- Callicladium
  - haldanianum 108 (184)
- Calliergon
  - cordifolium 98 (157)
  - giganteum 98 (158)
  - stramineum 97 (157)
- Calliergonella
  - cuspidata 104 (173)
- Calypogeia
  - integristipula 42 (62)
  - muelleriana 42 (62)
  - neesiana 42 (62)
- Campylium
  - chrysophyllum 97 (155)
  - hispidulum 107 (156)
  - stellatum 106 (156)
- Cephalozia
  - bicuspidata 50 (77)
  - lunulifolia 50 (77)
- Ceratodon
  - purpureus 89 (137)
- Chiloscyphus
  - pallescens 43 (64)
  - polyanthos 43 (64)
- Cladopodiella
  - fluitans 44 (68)
- Climacium
  - dendroides 96 (151)
- Conocephalum
  - conicum 23 (30)
- Dichelyma
  - pallescens 98 (162)
- Dicranella
  - heteromalla 86 (128)
  - varia 86 (128)
- Dicranum
  - flagellare 84 (123)
  - fuscescens 84 (122)
  - ontariense 83 (123)
  - polysetum 83 (121)
  - scoparium 84 (122)
- Diphyscium
  - foliosum 79 (112)
- Diplophyllum
  - albicans 38 (53)
  - apiculatum 38 (53)
  - taxifolium 38 (53)
- Distichium
  - capillaceum 79 (113)
- Ditrichum
  - flexicaule 85 (127)
  - lineare 86 (127)
- Drepanocladus
  - exannulatus 99 (163)
  - fluitans 99 (163)
  - uncinatus 98 (162)
- Encalypta
  - ciliata 90 (138)
- Entodon
  - cladorrhizans 106 (175)
  - seductrix 104 (175)
- Eurhynchium
  - pulchellum 101 (166)
- Fissidens
  - adiantoides 79 (113)
- Fontinalis
  - antipyretica 102 (167)
  - dalecarlica 102 (168)
  - novae-angliae 102 (168)

- Fossombronia
  - foveolata 46 (72)
- Frullania
  - bolanderi 41 (60)
  - brittoniae 41 (61)
  - eboracensis 41 (61)
  - oakesiana 41 (61)
  - tamarisci ssp. asagrayana 41 (60)
- Funaria
  - hygrometrica 89 (136)
- Geocalyx
  - graveolens 45 (68)
- Gymnocolea
  - inflata 49 (77)
- Harpanthus
  - scutatus 45 (68)
- Hedwigia
  - ciliata 102 (169)
- Helodium
  - blandowii 96 (152)
- Herzogiella
  - striatella 107 (181)
  - turfacea 107 (181)
- Heterocladium
  - dimorphum 103 (172)
- Homalia
  - trichomanoides 95 (150)
- Hygroamblystegium
  - tenax 99 (164)
- Hygrohypnum
  - ochraceum 99 (165)
- Hylocomium
  - splendens 103 (171)
  - umbratum 103 (171)
- Hypnum
  - cupressiforme 108 (183)
  - imponens 108 (182)
  - lindbergii 108 (183)
  - pallescens 108 (182)
- Isopterygium
  - elegans 102 (169)
- Jamesoniella
  - autumnalis 47 (73)
- Jungermannia
  - exsertifolia ssp. cordifolia 47 (73)
  - gracillima 47 (73)
  - leiantha 47 (73)
- Lejeunea
  - cavifolia 42 (58)
- Lepidozia
  - reptans 43 (63)
- Leptobryum
  - pyriforme 84 (124)
- Leptodictyum
  - riparium 99 (165)
- Leskea
  - polycarpa 100 (166)
- Leskeella
  - nervosa 96 (152)
- Leucobryum
  - glaucum 80 (114)
- Leucodon
  - brachypus var. andrewsianus 103 (170)
- Lophocolea
  - heterophylla 45 (69)
  - minor 45 (69)
- Lophozia
  - heterocolpos 46 (70)
  - incisa 46 (71)
  - longidens 46 (71)
  - rutheana 46 (70)
  - ventricosa 46 (71)
- Marchantia
  - polymorpha 23 (29)
- Marsupella
  - emarginata 49 (76)
  - sphacelata 49 (76)
- Metzgeria
  - conjugata 24 (34)
  - furcata 24 (34)
- Mnium
  - ambiguum 92 (141)
  - marginatum 92 (141)
  - spinulosum 92 (142)
  - stellare 92 (140)
- Mylia
  - anomala 43 (65)
- Myurella
  - julacea 105 (176)
  - sibirica 105 (176)
- Neckera
  - pennata 105 (177)
- Nowellia
  - curvifolia 48 (75)
- Oncophorus
  - wahlenbergii 82 (120)
- Orthotrichum
  - anomalum 91 (131)
  - obtusifolium 87 (131)
- Pallavicinia
  - lyellii 24 (33)
- Paraleucobryum
  - longifolium 83 (121)
- Pellia
  - epiphylla 24 (32)
- Phaeoceros
  - laevis 21 (22)
- Philonotis
  - fontana 91 (139)
- Physcomitrium
  - pyriforme 91 (139)
- Plagiochila
  - porelloides 47 (72)
- Plagiomnium
  - ciliare 92 (143)
  - cuspidatum 92 (142)
  - medium 93 (143)
- Plagiopus
  - oederiana 85 (125)
- Plagiothecium
  - cavifolium 104 (173)
  - denticulatum 104 (174)
  - laetum 104 (174)
- Platygyrium
  - repens 103 (170)
- Pleurozium
  - schreberi 103 (172)
- Pogonatum
  - alpinum 82 (119)
  - pensilvanicum 82 (119)

- Pohlia
  - cruda 95 (149)
  - nutans 95 (148)
  - wahlenbergii 95 (149)
- Polytrichum
  - commune 82 (118)
  - juniperinum 81 (117)
  - ohioense 82 (118)
  - piliferum 81 (116)
  - strictum 81 (117)
- Porella
  - pinnata 40 (59)
  - platyphylla 40 (59)
  - platyphylloidea 41 (59)
- Pottia
  - truncata 90 (138)
- Preissia
  - quadrata 23 (27)
- Pseudobryum
  - cinclidioides 93 (144)
- Pterigynandrum
  - filiforme 105 (177)
- Ptilidium
  - ciliare 37 (52)
  - pulcherrimum 37 (52)
- Ptilium
  - crista-castrensis 106 (179)
- Pylaisiadelpha
  - recurvans 105 (178)
- Pylaisiella
  - polyantha 108 (184)
- Radula
  - complanata 40 (58)
- Reboulia
  - hemisphaerica 23 (28)
- Rhacomitrium
  - aciculare 93 (146)
  - canescens 94 (145)
  - heterostichum 93 (146)
  - lanuginosum 94 (145)
- Rhizomnium
  - appalachianum 87 (130)
  - punctatum 87 (130)
- Rhodobryum
  - ontariense 91 (140)
- Rhytidiadelphus
  - loreus 107 (180)
  - subpinnatus 106 (179)
  - triquetrus 106 (180)
- Rhytidium
  - rugosum 95 (150)
- Riccardia
  - latifrons 25 (36)
  - multifida 25 (35)
  - palmata 25 (36)
- Riccia
  - fluitans 25 (26)
- Ricciocarpos
  - natans 23 (26)
- Saelania
  - glaucescens 94 (147)
- Scapania
  - gymnostomophila 40 (57)
  - irrigua 38 (54)
  - mucronata 40 (57)
  - nemorosa 39 (55)
  - paludicola 39 (56)
  - paludosa 39 (54)
  - umbrosa 39 (56)
  - undulata 39 (55)
- Schistidium
  - agassizii 89 (135)
  - apocarpum 88 (134)
  - maritimum 89 (135)
  - rivulare 88 (134)
- Sciaromium
  - lescurii 99 (164)
- Sphagnum
  - capillifolium 78 (110)
  - magellanicum 78 (110)
  - squarrosum 78 (109)
  - wulfianum 78 (109)
- Taxiphyllum
  - deplanatum 106 (178)
- Tetralophozia
  - setiformis 43 (65)
- Tetraphis
  - pellucida 80 (114)
- Thamnobryum
  - alleghaniense 96 (151)
- Thelia
  - hirtella 97 (154)
- Thuidium
  - abietinum 96 (153)
  - delicatulum 97 (154)
  - recognitum 97 (153)
- Timmia
  - megapolitana 95 (148)
- Tomenthypnum
  - nitens 97 (155)
- Tortella
  - fragilis 85 (126)
  - tortuosa 85 (126)
- Tortula
  - ruralis 93 (144)
- Trematodon
  - ambiguus 84 (124)
- Trichocolea
  - tomentella 37 (51)
- Tritomaria
  - exsectiformis 48 (74)
  - quinquedentata 48 (74)
- Ulota
  - coarctata 88 (132)
  - crispa 87 (132)
  - hutchinsiae 88 (132)
- Weissia
  - controversa 89 (136)

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